

F.R.g.

A N

E S S A Y

O N

A. 5861.

Comparative Anatomy.

—Vos minime fugit, plures esse humani corporis partes, quarum structura, & officium, etsi non aliunde quam ex bestiis desumpta sint, nunc tamen in Scholis accipiuntur, atque probantur.

Ant. M. Valsalva in dissert. Anatom. tertia.

Incidenda autem animalia, quibus partes illae, quarum actiones quaerimus, eadem atque homini sunt, aut certe similes iis; ex quibus sine metu erroris judicare de illis hominis liceat. Quin & reliqua, si modo aliquam habeant ad hominem similitudinem, quantulacunque sit, idonea sunt ad aliquid suppeditandum.

Albini Praef. ad Harvei Exercitationem de motu cordis.

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ADVERTISEMENT
TO THE
READER.

THE following Sheets were found among the Papers of a Physician lately deceased, and sent by a Friend of his to the Bookseller, with Liberty to print them. As the Subject appeared useful, they were presented to two eminent Physicians in Town for their Approbation: One of them was so good as to write the following Letter, which

with Difficulty we obtained leave
 to print, as it will serve for a
 Preface to the whole. From
 what he there says, in relation
 to the Subject and Treatise, we
 presume, the publishing it must
 be a Service done the Publick.



A
LETTER, &c.

S I R,

I HAVE read over the Papers on Comparative Anatomy, which I now return you with Thanks by this Bearer. You desire my Thoughts on the Subject and Treatise, and indeed the Pleasure I had in the perusal makes your demand but just. — What is called Comparative Anatomy, was certainly the first Branch of the Science that was cultivated, and from it the earliest Anatomists formed their Notions and System of the human Body. The natural Prejudices of Mankind, and in some Sense common Humanity opposed any Attempts to be made in the other Way. As the first Physicians were Philosophers, and this part of Natural Knowledge more immediately related to Medicine, they particularly applied to it. Democritus, who, accord-

ing to some, was the Master of Hippocrates, spent much Time in dissecting Brutes and examining their several Parts. He applied himself with such Eagerness to this Study, as to incur the Censure of Madness. His Design was to examine the Nature of the Bile, and learn the Seat and Causes of Diseases. That this Science was much improved by the Times of Hippocrates, is very apparent from his Writings, which are intermixed with Reasonings drawn from it, and some Parts of his Physiology are only applicable to Brutes. These Passages appear to us exceeding obscure, often false and contradictory, and have for that Reason been rejected by some very great Critics. — But is not this owing to our own Ignorance? We do not well understand the then received System of Anatomy, and his Terms and Names do not correspond to ours. The small *Traët de Vulneribus Capitis*, is I think as great a Master-piece in it's kind as the *Coacae Praedictiones*. Yet the first has been esteemed by some lame and imperfect; and afforded Occasion for many Disputes

Disputes and Wranglings, and all this because not understood : Anatomists however have done by Hippocrates in most Cases as the Critics with Homer, made him the Master of all human and divine Science. Not a new Division of a Bone, or Dispute about a Process or Articulation, but has been referred to his Judgment, and he has often been made to explain what he never dreamed of. Galen, the Father of Anatomists, is for the same Reason in many Places become an obscure Writer. He is accused and defended by the greatest succeeding Masters. Vesalius, the great Restorer of Anatomy, will not allow Accuracy or Truth in many of his Descriptions ; they are according to him taken from Brutes and obtruded on the World for human.

The other Anatomists treat Vesalius much in the same manner, and with uncommon Sagacity and unwearied Application have found out Variations and Lusus Naturae in particular Parts, that they may establish Galen's Descriptions and condemn those of Vesalius's.

This is particularly the Case with Eustachius in his Treatise on the Kidneys. How shall we now understand Galen, and judge between these great Anatomists? —

This Comparative Anatomy alone can extricate us from this Confusion, as it will teach us, when Galen and others described and reasoned from Brutes, and when not. We shall then find (I believe) that the greatest Part of his Descriptions was taken from Brutes, which he transferred by Analogy to the human Body, and so are inaccurate; that a few were taken from the human Subject, and are not capable of being otherwise applied. This Study he himself recommends with great Earnestness to his Scholars, and it is observable that the most eminent Anatomists first discovered their Genius, by an early Attachment to it. This was particularly the Case of Vesalius and Valsalva*.

* Gaudebat enim Avicularum, aliorumque Animalculorum dissectionibus, eorumque exta curiosius, quam pro illa aetate, rimabatur: quam ego praestificationem, non in Vesalio tantum, sed in aliis quoque Pueris fuisse scio, qui, cum adoleviscent, Anatomiae penitus se dediderunt. Morgagni Comment. de viri Valsalvae.

As the first Knowledge the Antients gained in Anatomy was from the Dissection of Brutes, so they formed the Names and Terms of Art from the most natural Appearance the Part afforded, and that in different Animals. Those Names were applied to the corresponding Parts in the human Body, and retained by succeeding Anatomists to avoid a Multiplicity of Words. This however produces one bad Effect, that it may mislead us in our Conceptions, as those Names are often very improper Epithets in the human Subject. The Author has elegantly remarked several of these. The Name of right and left Ventricle is apt to give a wrong Idea of the Position of the Heart, and the Aorta ascendens and descendens has imposed on some of the Masters in Anatomy, who it's plain have taken their Figures from the Name. Disputes have arisen about the Appendix Vermiformis, &c. which are all cleared up when we once view the Part in the Animal whence the Name was taken. A short Technical Dictionary, with an Account of the

the Subjects whence the Names of the several Parts were derived would be of great Use to Students, and is one of the Desiderata in Anatomy.*

The Intention of Nature in the Formation of the different Parts, can nowhere be so well learned as from this Science; that is, if we would understand Physiology and reason on the Functions in the animal Oeconomy, we must see how the same End is brought about in other Species.—We must contemplate the Part or Organ in different Animals, it's Shape, Position, Connexion with the other Parts, &c. and observe what thence arises—if we find one common Effect constantly produced, though in a very different Way, then we may safely conclude that this is the Use or Function of the Part; this Reasoning can never betray us, if we are but sure of the Facts. The Writers in Physiology have generally taken another Rout, and one favourite Thesis

* Such a Treatise might in a great measure be collected from Sylvius's Works, and Foetus's *Oeconomia Hippocratica*. Camerarius did such a Work under the Title of *Διανοητὴ ὁνομασία*, but it is a rare Book.

or other serves to explain the whole or
 most of the System. An innate and con-
 cocting Heat, Acids, Menstruums, &c.
 have all had their successive Reigns and
 Patrons, And in Truth, Physicians
 seem not to have sufficiently considered
 the Importance of this Study to form a
 complete Physiology, which must ever be
 the great Basis of their Art. They have
 bestowed Pains in examining the human
 Body, dissected minutely it's several
 Parts, traced out (perhaps often in-
 vented) a new Division of a Muscle,—
 but how little has Physick been promoted
 by all this? The most accurate De-
 scription of the human Stomach, with
 all it's Veins, Arteries, Nerves, &c.
 will never rightly explain Digestion.—
 What must we then do? — examine it
 in the other Species of Animals, mark there
 it's Differences and the Effects, compare
 these with the human, and then shall we
 in some Measure be able to judge, what
 are the principal Instruments and how
 they are employed in this compound Ac-
 tion. Any other Way of Reasoning (as
 the Author well observes) will never
 bring

bring us to the Solution of a Philosophical or Medical Problem. It must indeed be confessed, that this Method is tedious and slow; many Observations must first be made, and the Labour of searching and examining gone through, before we can have proper Materials to build on. Yet these are the hard Conditions on which the Knowledge of natural Causes is to be obtained, which, as a great Genius says, *Tam facile solertia vinci possunt, quam solent conatibus vulgaribus difficulter cedere.*

Of this kind of Reasoning, we have many beautiful Instances in the following Papers; such is the Account of the Position of the Duodenum, the History of the Thymus and Thyroid Gland, their Use and mutual Proportion, the Use of the Spleen, &c. This last he explains in so short and masterly a manner, as you'll find more Argument in the few Lines upon it, than is to be collected from whole Treatises on the Subject. But as his Design was to give a Description of the several Species, or rather their principal Differences, he chiefly confines himself to
this :

this : So in the *Anatomy* of the Dog he compares the different Position, Shape, Length, &c. of the several Parts with the corresponding Parts in Man, and from that one Circumstance, the Difference of an erect and horizontal Posture, explains all the Variations. This Reasoning then gives Solution to many Difficulties in the human *Anatomy* ; why the Spleen so firmly attached to the Diaphragm, why the Omentum reaches only so far, why the posterior Part of the Bladder only covered by the Peritonæum, &c. — There have been Disputes about the Fissure in the human Liver, and different Accounts given. These all vanish, when we consider this Viscus in different Animals. We then find that there are more or fewer Divisions, according to the greater or lesser Flexility of the Spine. The same Rule holds with regard to the Divisions of the Lungs. This Reasoning likewise excludes the pretended Use of the Ligament in the human Liver. And in short we can understand but little of our own Structure, unless we study that of other Animals ; we shall then find that

that the several Variations are relative and depend on the different Way of Life; that is, one leading Speciality draws after it a great many more, in which Nature is always an Oeconomist and takes the shortest Rout.

The beautiful Gradation of Nature in the different Orders of Beings, is very remarkable, and strikes the Mind first, as being most obvious; but when we take any one Species, the Case there is still the same, and we observe as surprising a Difference. Thus in the Animal Kingdom, some are provided with Lungs, when others are deprived of these breathing Organs; some have a muscular Diaphragm and strong Abdominal Muscles, others a mere Membrane; some have Lacteals; others want them. It must be very entertaining to learn how these Differences and Deficiencies are adjusted and supplied; 'tis then from this Science alone we can understand that Simplicity of Nature, which is much talked of, and but little understood. Hence likewise we must learn what to think of Animals perfect and imperfect.—

Ana-

Anatomists have made a Noise about the different Structures of the same Part in the human Body, and been at great Pains to make Collections of those Lusus Naturae as they call them; which, because they are rare, are for that very Reason of no great Consequence to be known. The Epithet however is extremely proper, for the most remarkable of them are Transitions from the Order or Law of Nature that obtains in one Species, to that of another. Thus it has been observed (though very rarely) that the Liver was situated in the left Hypochondrium, but as our Author remarks, it is not peculiar to it to lye on the Right-side in Animals; for in Fowls it lies equally on both, and in Fishes mostly on the left.

It is surprising that we have no tolerable Treatise on this Subject, which is in itself so entertaining and so conducive to promote Medicine. Those, who have made Attempts this Way, have only collected and ranged in Order some particular Species, such as Birds or Fishes. They have likewise with great Labour

Labour given us Figures and Descriptions of them, — but all this is little else than mere Amusement. 'Tis the Structure of their internal Organs we seek after, and the manner how the different Functions of the animal Oeconomy are performed. Their Histories of these are every way defective and erroneous. There are indeed noble Hints to be found in the Writings of some of our modern Anatomists, particularly those of the immortal Dr. Harvey. That great Man, well understood the Importance of this Science to advance Medicine, and accordingly employed the most of his Time in dissecting Animals of different Tribes, and making Experiments on them: by which Means he made the greatest Discovery that ever was in the Science, and laid the Foundation of the present System. He had certainly left us other Treatises on this Subject, had he not been interrupted by the Civil Wars. The Physicians who lived then, imitating his Example, made many new Experiments on the Bodies of Brutes, changing their Juices by transfusing

2

of

of new Liquors, accurately marking the Effects, &c. that all this might be transferred to the human Body; and indeed, from the Application of these Reasonings, to the Observations they made on morbid Bodies, the Science seemed fast advancing to that physical Certainty, which can be attained from Experiment and Observation. But alas! this Spirit died with these great Men, and Theory and Calculation came in, it's Place. Mathematics, it was said, could alone bring the Science to Certainty, and throw out Conjecture. The Quantity and Velocity of the Blood, the Force of the Heart, Diameters of the Vessels, &c. were subjected to Measure and Number, and Diseases next were to be accounted for all in a mathematical Manner. — This Method however did not succeed according to Wish; for first those great Genius's disagreed widely in their Calculations, and differed from one another; whence in place of certain Conclusions we had only Wranglings and Disputes: not to mention, that some of

them made such Estimates, as must plainly appear ridiculous at first Sight*. This, you'll say, proves nothing, it was the Fault of the Artists, who assumed wrong Hypotheses for their Calculations, or were not perhaps accurate in their Observations. True,—but whose Fault was it to adapt Figure and Number to a Subject which refuses them, through it's numberless Deviations from fixed Laws and Conditions?—Is an animate Body a mere Bundle of hard conical elastic Tubes, and the Heart a Pump forcing the Liquors through? Are then all the Vessels exact Cones, or have any two

*The ingenious Dr. Pitcairn was the chief Man in these Parts, who gave into this Way. He supposes the Force of Muscles to be in a compound Ratio of their Length, Breadth and Depth; that is, as they are homogeneous Solids in the Ratio of their Weights. Whence knowing the Force of any one Muscle, we can by the Rule of Proportion (from their Weights) determine that of another. This he applies to the Stomach, and by the Computation it's muscular Force is equal at least to 117088 lb. Weight.—That Muscles are in that Proportion, is a mere Hypothesis, for which the Doctor does not offer the smallest Proof; and had he assigned five Ounces as the Weight of the Stomach, he had been nearer the Truth. This is one glaring Instance, how much Theory and Whim may prevail with the greatest of Men over common Sense.

Anatomists

Anatomists agreed in their Measures of them? Do they not yield every Way? And are they not continually obstructed in different Places? Are there not many different Attractions prevailing for the several Secretions, and many different Forces acting on the Vessels at the same Time which can never be determined? &c. These and such like Considerations will soon convince us how little the Practice of Medicine is to be promoted by those Speculations*. If these Gentlemen meant by mathematical Reasoning physical Experiments, then no one ever doubted of this, no more than they do of the Use of Mathematicks in Natural Philosophy it self. But as this seems not to be their Sense of the Matter,

* The Authority of Hippocrates is often adduced in this Argument, for which they cite two Passages. In the one he recommends the Study of Astronomy, as necessary to a Physician, and in the other, that of Arithmetic and Geometry. — The first he did from his Belief in the Influence of the Stars, and the second from his Veneration for the Pythagoric Numbers; in the Mysteries of which he founded his Theory of the Crises in acute Diseases: Both those Considerations then are foreign to the Purpose, nor is there in any of his genuine Writings the smallest Vestige of this kind of Reasoning. On the contrary Celsus says of him, *Primus ab studio Sapientiae Medicinam separavit.*

they should point out a few Diseases which this Science has explained, and wherein it has corrected the received Practice. — But I am quite got from the Subject to what is foreign. To return then, Comparative Anatomy has hitherto been treated but by Pieces. Thus some writing on the human Eye, have examined the Eyes of other Animals, and so with regard to the Heart, &c. Some have given us the Description of one particular Animal, others of another. But no one Author, as I know of, has given us a System of this Science where we might have a summary View of the most material Differences in the Structure of Animals. There are indeed Compendis of this Science if you will, which are esteemed by many, and were wrote with the noble Design of illustrating the Wisdom and Goodness of our Maker. But those who composed them were not Anatomists themselves, so could only collect from others, which they often do without any Judgment—for how voluminous soever their Works may be, yet if you'll strip them

them of their repeated Exclamations, Citations of Authors and Books, the many strange and surprizing Stories, all told however by creditable Vouchers, you'll have little left behind besides an indigested Chaos of Histories and Descriptions, some true and many false. The Argument however was popular, and they could not fail of pleasing.

The Author of these few Sheets is certainly a great Master of the Subject, and has here laid down an useful Plan, which will not be difficult for others to compleat. The Descriptions, 'tis easy to see, are all taken from the Life, and his Reasoning plain and conclusive. These are intermixed with many practical Observations in Medicine and Surgery, which must equally instruct and entertain the Reader. — You have now a few loose Reflections on this Subject, wherein I have entirely confined myself to that Light, in which it is here treated. I shall only remark one Thing more, that the Author's Modesty is at least equal to his Capacity and Knowledge ;

Knowledge ; a rare Quality to be met with in an Anatomist ! Read him on the Subject of the Human Allantois, and observe his Conclusion of the Argument. You must then say, it had been happy for the Publick, if half so much Candour and Self-diffidence had prevailed in the Disputes among the Learned. The World had been more instructed, and they more justly esteemed.

I am, Sir,

Your most humble Servant.



A N
E S S A Y

O N
Comparative Anatomy.

The INTRODUCTION.



THE principal Advantages *The Uses*
of Comparative Anatomy *of Compa-*
are the following: First, *rative A-*
natomy.
It furnishes us with a suf-
ficient Knowledge of the different Parts
of Animals, to prevent our being
imposed upon by such Authors who
have delineated and described feve-
B ral

THE INTRODUCTION.

ral Parts from Brutes as belonging to the human Body. Secondly, It helps us to understand several Passages in the ancient Writers in Medicine, who have taken many of their Descriptions from Brutes and reasoned from them ; their Reasonings have often been misapplied (and consequently wrong explained) by the Moderns through a foolish Fondness to support their own Inventions, or give an Air of Antiquity to a favourite Hypothesis. The third and great Use we reap from this Science, is the Light it casts on several Functions in the human Oeconomy about which there have been so many Disputes among Anatomists : These will be in a great Measure cleared up by exhibiting the Structure of the same Parts in different Animals, and comparing the several Organs imployed in performing the same Action, which in the human Body is brought about by one more complex.

*How the
Action of
Muscles is
deter-
mined.*

In this View 'tis altogether needless to insist on those Parts whose Use is easily

easily understood when once their Structure is unravelled ; thus for Instance, if we be acquainted with the Action of the Muscles in general, it will not be difficult to determine the Use of any particular Muscle, whose Origin and Insertion is known, if we at the same Time consider the various Connexions of the Bones to which it is fixed, and the different degree of Mobility they have with Respect to each other : In the same Manner if we know the Use of the Nerves in general, we can easily assign the Use of those Nerves which are distributed to any particular Part. There is then no Occasion for a complete *Osteology*, *Myology*, &c. of the several Animals we shall treat of, nor need we trouble ourselves about the Structure of any of the Parts, unless when it serves to illustrate some of the fore-mentioned Purposes.

That the first Use we proposed from examining the Structure of the Parts in Brutes is real and of Consequence,

THE INTRODUCTION.

quence, is evident from looking into the Works of some of the earliest and greatest Masters of Anatomy, who for want of human Subjects have often borrowed their Descriptions from other Animals. The great *Vesalius*, although he justly reproves *Galen* for this Fault, is guilty of the same himself, as is plain from his Delineations of the Kidneys, *Uterus*, the Muscles of the Eye and some other Parts. Nor is Antiquity only to be charged with this, since in *Willis's Anatomia Cerebri* (the Plates of which were revised by that accurate Anatomist Dr. *Lower*) there are several of the Pictures taken from different Brutes, especially the Dog, besides those he owns to be such.

We shall give several Examples of the second Use in the Sequel of the Work.

The Variety and Uniformity observable in Nature.

The Animal Kingdom, as well as the Vegetable, contains the most surprising Variety, and the Descent in each

each is so gradual, that the little Transitions and Deviations are almost imperceptible. The Bat and Flying-Squirrel, though *Quadrupeds*, have Wings to buoy themselves up in the Air. Some Birds inhabit the Waters, and there are Fishes that have Wings, and are not Strangers to the airy Regions; the Amphibious Animals blend the Terrestrial and *Aquatic* together.

The animal and vegetable Kingdoms are likewise so nearly connected, that if you take the highest of the one, and the lowest of the other, there will scarce be preserved any Difference: For Instance, what Difference is there betwixt an Oyster, one of the most inorganised of the animal Tribe and the sensitive Plant, the most exalted of the vegetable Kingdom? They both remain fixed to one Spot, where they receive their Nourishment, having no proper Motion of their own, save the shrinking from the Approach of external Injuries.

Thus we observe a surprising Chain in Nature.

As there is then such a vast Variety, it is not only needless but impossible to consider all of them particularly. We shall take only some of the most remarkable *Genera*, and hope from what will be said of them any of the intermediate Degrees may be understood.

*Division of
Animals
into Qua-
drupeds,
Volatiles,
Fishes, and
Insects.*

In treating of *Quadrupeds*, we shall divide them into the *Carnivorous*, i. e. those that feed indifferently on animal and vegetable Substances, and *Granivorous*: As an Instance of these last we shall take the ruminant Kind. The Fowls we shall also divide into those that feed on Grain, and those that feed on Flesh. The Distinction we shall make in treating of Fishes, shall be of those that have Lungs, and those that have them not. The first indeed are with Difficulty procured, and at the same Time differ very little from *Quadrupeds*.

As

As the Structure of Insects is so very minute, and lends us but little Assistance for the Ends proposed, we purposely omit them.

In inquiring into the Structure of different Animals, we ought to be previously acquainted with the form of their Body, manner of Life, kind of Food; or in short, with their natural History, which will lead us to account for the reason of their different Structure, and thence explain the Actions of the human Body.

Of Quadrupeds in general.

ALL *Quadrupeds* have a Covering of Hair, Wool, &c. to defend them from the Injuries of the Weather, which varies in Thickness according to the Season of the Year, and Difference of the Climate: Thus in *Russia* and the Northern Countries, the Furs are very thick and warm, while the little *Spanish* Lap-dogs, and *Barbary* Cows, have little or no Hair at all.

Cuticula,
Cutis,
Panniculus
Carnosus. The *Cutis* and *Cuticula* in *Quadrupeds* are disposed much in the same Way as the human, only more elastic; immediately under this, there is a very thin cutaneous muscular Substance called *Panniculus Carnosus*, which is common to all *Quadrupeds*, the *Porcine* Kind excepted; this principally covers the Trunk, serving to shrivel the Skin, in order to drive off Insects, their Tails and Heads not being sufficient for this Purpose, while their

Extre-

Extremities are employed in their Support and Progression.

It has probably been from observing ^{Whence} some Muscles of the human Body, ^{the Notion} such as the *Platysma Myoides*, *Creniculus* ^{of the Panniculus} *master*, and *Frontales*, and the *col-* ^{Carnosus,} ^{&c.} lapsed *Tunica Cellulosa* of emaciated Subjects, to resemble this thin Muscle, that some of the older Anatomists reckoned such a *Panniculus* among the common *Teguments* of the human Body. This *Carolus Stephanus* has well observed.

Most part of *Quadrupeds* want ^{Why most} *Clavicles*, whereby their anterior *Ex-* ^{Quadrupeds want} *tremities* fall upon their Chest, so as ^{Clavicles.} to make their *Thorax* proportionally narrower than the Human. This small Distance of their anterior *Extremities* is very necessary for their uniform Progression: Apes indeed and Squirrels have *Clavicles* to allow them a more full Use of their *Extremities* in climbing, but when they sit down on all-four they walk but indifferently.

The

The Anatomy of a Dog.

WE may first observe of this Animal, as indeed of most *Quadrupeds*, that it's Legs are much shorter in Proportion to it's Trunk than in Man, the length of whose Steps depends entirely on the length of his inferior Extremities; however to balance this the Trunk of the Animal is proportionally longer and smaller, his Spine more flexible, by which he is able at each Step to bring his posterior Extremities nearer to his anterior. His common *Teguments* are much a-kin to those of other *Quadrupeds*, only they allow little or no Passage for Sweat, but when he is over-heated the superfluous Matter finds an Exit by the Salivary Glands, for he lolls out his Tongue and flavers plentifully.

Cutis.

Abdomen,
Musculi
Pyram.

The pyramidal Muscles are wanting, to supply which the *Rectus* is in-

Comparative Anatomy.

II

inserted fleshy into the *Os Pubis*.

The *Omentum* reaches down to the *Os Pubis*, which considering the Posture of the Animal we will find to be a wise Provision, since it's Use is to separate an oily Liquor for lubricating the Guts and facilitating their peristaltick Motion; so in our erect Posture the natural Gravity of the Oil will determine it downward, but in the horizontal Position of these Creatures, if all the *Intestines* were not covered, there would be no favourable Derivation of the Fluid to the Guts lying in the posterior Part of the *Abdomen*, which is the highest; and besides, had the *Omentum* reached much farther down in us, we had been in continual Hazard of an *Epiplocele*, which the Dog is not subject to as his *Viscera* don't press so much on the Rings of the *Abdominal* Muscles. The inferior and anterior *Lamella* of the *Omentum* is fixt to the Spleen, *Fundus* of the Stomach, *Pylorus*, Liver, &c. in the same Way as the human,

man, but the superior having no *Colon* to pass over, goes directly to the Back-bone. This serves to explain the Formation of the small *Omentum* in the human Body, which is nothing but the large *Omentum*, having lost it's Fat, passing over the Stomach and *Colon*, where it re-assumes it's *Pinguedo*, so proceeds and is firmly attached to the Liver, Spine, &c. The Striæ of Fat are pretty regularly disposed through it, accompanying the Distribution of the Blood-Vessels to guard them from the Pressure of the Super-incumbent *Viscera*.

Ventriculus.

This Animal's Stomach, though pretty much resembling the human in it's Shape, is somewhat differently situated. It lies more longitudinal, as indeed all the other *Viscera* do to accommodate themselves to the Shape of the Cavity in which they are contained, that is, it's inferior Orifice is much farther down with respect to the superior than the human: By this Means the gross Food

Food has an easier Passage into the *Duodenum*. Again, the *Fundus* of the human Stomach, when distended, stands almost directly forwards, which is occasioned by the little *Omentum* tying it so close down to the Backbone, &c. at it's two Orifices; but it not being fixed in that manner in the Dog, the *Fundus* remains always posterior: This also answers very well the Shape of the different Cavities, the Distance betwixt the *Cardia* and *Fundus* being greater than that betwixt the two Sides. It seems to be much larger in Proportion to the Bulk of the Animal than the human; that it might contain a greater Quantity of Food at once, which was very necessary, since this Animal cannot at any Time get it's Sustainance as Men do. The *Turbillion* is not so large, nor is there any Coarction forming the *Antrum Willisii* as in the Stomach of Man. It is considerably thicker and more muscular than ours for breaking the Cohesion of their Food, which they swallow without sufficient

cient chewing. Hence it is evident the Force of the Stomach is not so great as some would have it, nor it's Contraction so violent; otherwise that of Dogs would be undoubtedly wounded by the sharp Bones, &c. they always take down; for the Contraction here is still greater than in the human Stomach, which is much thinner. The *Rugæ* of the *Tunica Villofa* are neither so large nor situated transversely as in the human, but go from one Orifice to the other; the reason of which Difference is, perhaps, that they might be in less Danger of being hurt by the hard Substances this Creature frequently feeds upon, and for the same reason there is not the like Coarction at their *Pylorus*.

Intestines.

The *Intestines* of this Animal are proportionally much shorter than ours, for the Food which these Creatures mostly uses, soon dissolves and then putrifies; on which Account there was no Occasion for a long Tract of *Intestines* but on the contrary that it should be quickly thrown out of the Body: the

same

same is to be observed of all the carnivorous Animals. The muscular Coat of the Intestines is also stronger than the human, to protrude the hard Bones, lest they should stop somewhere in the Canal.

The *Valvulae Conniventes* are less numerous, and in a longitudinal Direction.

The *Duodenum* differs considerably in it's Situation from the human; for in Man it first mounts from the *Pylorus* upwards, backwards, and to the Right-side, then passes down by the Gall-bladder, and marching over the Right-kidney and superior Part of the *Psoas Muscles*, makes a Curvature upwards, and passes over the Backbone and *Vena Cava inferior*, to the left *Hypochondrium*, where it gets through the *Omentum*, *Mesentery* and *Mesocolon* to commence *Jejunum*, being firmly tied down all the way, the *Biliary* and *Pancreatic Ducts* entering at it's most depending Part : whereas
in

in the Dog the *Duodenum* is fixed at the *Pylorus* to the concave Surface of the Liver, and hangs loose and pendulous with the *Mesentery* backwards into the Cavity of the *Abdomen*, then turning up again is fixed to the Back-bone, where it ends in the *Jejunum*; the Bile and *Pancreatic* Juice are poured into it at the most depending Part; therefore the same Intention seems to have been had in View in the Formation of this Part in both, viz. the giving the Chyle, after the Liquors of the Liver and *Pancreas* are poured into it, a disadvantageous Course, that so it might be the more intimately blended with the Humours before it's Entry into the *Jejunum*, where the *Lacteals* are very numerous: And thus by reason of their different Posture, the same Design (though by a very different Order of the Parts) is brought about in both.

*Intestina
Tenuia.*

The other small Guts are much the same with ours, only shorter. The great Guts are also shorter and less capacious

capacious than in the human Body ; and we take it for a general Rule, that all Animals that live on vegetable Food, have not only their small Guts considerably longer, but also their great Guts more capacious than such Creatures as feed on other Animals. Hence Man from this Form of his *Intestines* and that of the *Teeth*, seems to have been originally designed for feeding on Vegetables, and still the most of his Food and all his Drink is of that Class.

The reason of this Difference seems to be, that as animal Food is not only much more easily reduced into *Chyle*, but also more prone to Putrefaction, too long a *Remora* of the Juices might occasion the worst Consequences. So it was necessary that their Receptacles should not be too capacious, but on the contrary, being short and narrow, might conduce to the seasonable Discharge of their Contents. Whereas vegetable Food being more difficultly dissolved and converted into an animal Nature,

there was a Necessity for such Creatures as fed on it to be provided with a long internal Canal, that this Food in it's Passage might be considerably retarded, and have Time to change it's *Indoles* into one more agreeable to our Nature. Besides which, there is another Advantage which accrues to Man in particular, from having his great Guts very capacious; for as he is a rational Being, and mostly employed in the Functions of social Life, it would have been very inconvenient as well as unbecoming for him to be too frequently employed in such ignoble Exercises, so that having this large Reservoir for his *Fæces Alvine*, he can retain them for a considerable Time without any Trouble.

*Appendix
Vermiformis.*

The *Appendix Vermiformis* justly enough deserves the Name of an *Intestinum Cecum* in this Subject, though in the human Body it does not, and has probably been from the Largeness of this Part in other Animals, that the oldest Anatomists came to reckon that

that small *Apendicule* in Man as one of the great Guts : On it's internal Surface we observe a great Number of mucous Glands.

The *Colon* has no longitudinal *Li-* *Colon*
gaments, and consequently this Gut is not purfed up into different Bags or Cells as the human, nor does this *Intestine* make any circular Turn round the *Abdomen*, but paffes directly a-cross it to the top of the *Os Sacrum*, where it gets the Name of *Rectum*.

At the Extremity of the *Intestinum* *Rectum*
Rectum or Verge of the *Anus*, there are found two Bags or Paunches which contain a most abominable fetid Mucus for which I know no Use, unless it ferves to lubricate the strained Extremity of the *Rectum*, and defend it againft the Asperity of the *Fæces*, or to feparate fome Liquor that might otherwife prove hurtful to their Bodies. There is nothing analogous to thofe Sacs in the human Subject, unless we reckon the mucilaginous Glands that are
C 2 found

found most frequent and largest about the lower Part of the *Rectum*.

Mesentery.

The *Mesentery* is considerably longer than in the human Body, for in Man had the *Mesentery* been very long, the Guts would have fallen down on the Stomach, &c. by reason of his erect Position. The Fat is here disposed in the same Way, and for the same Reason, as in the *Omentum*. The *Interstices* betwixt the Fat are filled with a fine Membrane. Instead of a great Number of *Glandulæ Vagæ* to be found in the human *Mesentery*, there is only one large Gland to be observed in the middle of the *Mesentery* of a Dog, which from it's imagined Resemblance to the *Pancreas* and the Name of it's Discoverers, is called *Pancreas Asellii*. The reason why this in Man is as it were subdivided into many smaller ones, may possibly be, that as the Guts of a human Body are proportionally much longer than those of this Creature, it would have been inconvenient to have gathered all the

*Pancreas
Asellii.*

the *Lactea primi generis* into one Place, whereas by collecting a few of these Vessels into a neighbouring Gland the same Effect is procured much more easily.

The *Pancreas* in Man lies cross the *Pancreas*. *Abdomen*, tied down by the *Peritoneum*; but the Capacity of this Creature's *Abdomen* not allowing of that Situation, it is disposed more longitudinally, being tied to the *Duodenum* which it accompanies for some Way. It's *Duct* enters the *Duodenum* about half an Inch below the others.

The Spleen of this Animal differs *Spleen*. from ours very much, both in Figure and Situation. It is much more oblong and thin, and lyes more according to the Length of the *Abdomen*, like the *Pancreas*. Though the Spleen of this Creature is not firmly tied to the *Diaphragm* (which was necessary in our erect Posture to hinder it from falling downwards) yet by the Animal's prone Position, it's posterior

Parts being rather higher than the anterior, it comes to be always contiguous to this Muscle, and is as effectually subjected to an alternate Pressure from it's Action as the human Spleen is.

Liver.

The human Liver has no *Fissures* or Divisions, unless you please to reckon that small one betwixt the two *Pylæ*, where the large Vessels enter: Whereas in a Dog and all other Creatures that have a large Flexion in their Spine, as Lions, Leopards, Cats, &c. the Liver and Lungs are divided into a great many Lobes by deep Sections, reaching the large Blood-Vessels which in great Motions of the Back-bone may easily shuffle over one another, and so are in much less Danger of being torn or bruised, than if they were formed of one entire Piece, as we really see it is in Horses, Cows, and such Creatures as have their Back-bone stiff, and immoveable. There is here no *Ligamentum Latum* connecting the Liver to the *Diaphragm*, which in our Situation

tuation was necessary to keep the *Viscus* in it's Place; whereas in this Creature it naturally gravitates forwards, and by the horizontal Position of the Animal is in no Danger of pressing against the *Vena Cava*: The preventing of which is one Use generally assigned to this *Ligament* in Man. Had the Liver of the Dog been thus connected to the *Diaphragm*, the Respiration must necessarily have suffered; for as we shall see afterwards, this Muscle is here moveable at the Center, as well as at the Sides: But in Man the Liver is fixed to the *Diaphragm*, mostly at it's tendinous Part; that is, where the *Pericardium* is fixed to it on the other Side, so that it's in no Danger of impeding the Respiration, being suspended by the *Mediastinum* and Bones of the *Thorax*. In Consequence of this *Viscus* being divided into so many *Lobes*, it follows that the *Hepatic Ducts* cannot possibly join into one common Trunk till they are quite out of the Substance of the Liver.

Kidneys.

We come next, after having examined the *Chylopoietic Viscera* to discourse of those Organs that serve for the Secretion and Excretion of Urine, and first of the Kidneys, which in this Animal are situated much in the same Way as in the human Subject, but have no Fat on their inferior Surface, where they face the *Abdomen*, and are of a more globular Form than the human. The reason of these Differences will easily appear, if you compare their Situation and Posture in this Animal with those in a Man who walks erect. They are placed in this Subject in the inferior Part of the Body, so are not subject to the Pressure of the *Viscera*, which seems to be the principal Cause of the Fatness of those Organs in us, and perhaps may likewise be the Cause of our being more subject to the Stone than other Animals. Hence there is no need of any cellular Substance to ward off this Pressure where there would necessarily be Fat collected; but the superior
Part

Part of their Kidneys is pretty well covered with Fat, lest they should suffer any Compression from the Action of the Ribs and Spine.

In the *internal* Structure there is *Papillæ*. still a more considerable Difference, for the *Papillæ* don't here send out single the several *Tubuli Uriniferi*, but being all united they hang down in Form of a loose pendulous Flap in the middle of the *Pelvis*, and form a kind of *Septum Medium*, so that a Dog has a *Pelvis* formed within the Substance of the Kidney. The only thing that is properly analogous to a *Pelvis* here, is that Sac or Dilatation of *Pelvis*. the *Ureters* formed at the Union of the *Ductulæ uriniferae*. The reason of these Particularities may probably be, that the Liquors of this Animal, as of all those of the carnivorous Kind, being much more acrid than those that live on vegetable Food, it's Urine must incline much to an Alcalescency, as indeed the Smell and Taste of that Liquor in Dogs, Cats, Leopards, &c. evidently shew, being
fetid

fetid and pungent, and therefore not convenient to be long retained in the Body. For this End it was proper, that the secerning Organs should have as little Impediment as possible by Pressure, &c. In the performing their Functions; and for that Design, the Mechanism of their Kidneys seems to be excellently adapted: We have most elegant Pictures in *Eustachius* of the Kidneys of Brutes delineated, as such, with a View to shew *Vesalius's* Error in painting and describing them for the human,

*Capsulæ
Atrabilarie.*

The *Glandulæ* or *Capsulæ Atrabilarie* are thicker and rounder than the human, for the same reason as the Kidneys.

Ureters.

The *Ureters* are more muscular than the human, because of the favourable Passage the Urine has through them; they enter the *Bladder* near it's *Fundus*.

The

The Bladder of Urine differs considerably from the human, and first in its Form, which is pretty much pyramidal or pyriform, this Shape of the Dog's Bladder is likewise common to all *Quadrupeds*, except the Ape and those of an erect Posture. In Men it is by no Means pyriform, but has a large Sac at its posterior and inferior Part: This Form depends entirely on the Urine gravitating in our erect Posture to its Bottom, which it will endeavour to protrude, but as it cannot yield before being contiguous to the *Os Pubis*, it will naturally stretch out where there is the least Resistance, that is, at the posterior and lateral Parts; and were it not for this Sac we could not come at the Bladder to extract the Stone either by the lesser or lateral Operation of *Litbotomy*. Most Anatomists have delineated this wrong, so much, that I know of none who have justly painted it, excepting Mr. *Cowper* in his *Myotomia*, and Mr. *Rutley*. It has certainly been from observing it

Vesica Urinaria.

in Brutes, and young Children, that they have been led into this Mistake. The same Cause, *viz.* the Gravity of the Urine makes the Bladder of a different Form in Brutes; in their horizontal Position the *Cervix*, from which the *Urethra* is continued, is higher than it's *Fundus*, the Urine must therefore distend and dilate the most depending Part by it's Weight.

Connection.

As to it's Connection it is fastened to the *Abdominal* Muscles by a Process of the *Peritoneum*, and that Membrane is extended quite over it; whereas in us it's superior and posterior Parts are only covered by it: Hence in Man alone the high Operation of *Lithotomy* can be performed without Hazard of opening the Cavity of the *Abdomen*. Had the *Peritoneum* been spread over the Bladder in it's whole Extent, the Weight of the *Viscera* in our erect Posture would have so bore upon it, that they would not have allowed any considerable Quantity of Urine to be collected there; but we must have

Why the human Bladder but in Part covered by the Peritoneum.

been obliged to discharge it's Contents too frequently to be consistent with the Functions of a social Life. Whereas by Means of the *Peritoneum* the Urine is now collected in sufficient Quantity, the *Viscera* not gravitating this Way.

You may take it for a general Rule, that those Creatures that feed upon animal Food have their Bladder more muscular and considerably stronger, and less capacious than those that live on Vegetables, such as Horses, Cows, Swine, &c. whose Bladder of Urine is perfectly membranous, and very large. This is wisely adapted to the Nature of their Food, for in these first, as all their Juices are more acrid, so in a particular manner their Urine becomes exalted, which as it's *Remora* might be of very ill Consequence, must necessarily be quickly expelled. This is chiefly effected by it's stimulating this *Viscus* more strongly to contract, and so discharge it's Contents. That a *Stimulus* is one of the principal Causes of

*A Stimulus
proved to
be a prin-
cipal Cause
of the E-
vacuation
of the
Bladder.*

of the Excretion of Urine, we learn from the common saline diuretic Medicines that are given, which are dissolved into the *Serum* of the Blood, and carried down by the Kidneys to the Bladder: The same appears likewise from the Application of *Cantbarides*, or without any of these, when the Parts are made more sensible, as in an Excoriation of the Bladder, there is a frequent Desire to make Water. Accordingly we find these Animals evacuate their Urine much more frequently than Man, or any other Creature that lives on vegetable Food. And if these Creatures, whose Fluids have already a Tendency to Putrefaction, are exposed to Heat or Hunger, the Liquids must for a considerable Time undergo the Actions of the containing Vessels, and frequently perform the Course of the Circulation without any new Supplies of Food, by which the Fluids becoming more and more acrid, the Creature is apt to fall into feverish and putrid Diseases; and in Fact we find that these Causes are sufficient

*Causes
assigned
for the
Rabies
Canina,
&c.*

sufficient to produce that fatal and melancholy Distemper the *Rabies Canina*, *Vulpina*, &c. in these Animals; whereas those that feed on vegetable Food seldom or never contract these Diseases but by Infection.

The *Spermatic* Vessels are much the same way disposed as in us; they are contained within the Cavity of the *Abdomen*, as the Guts are within the *Peritoneum* which is spread over them, and from which they have a Membrane like a *Mesentery*, so hang loose and pendulous in the *Abdomen*: whereas in us they are contained in the cellular Part of the *Peritoneum*, which is tensely stretched over them. At their Passage out of the lower Belly, there appears a plain Perforation or Holes, and from observing this in *Quadrupeds* has arisen the false Notion of *Hernia* or Rupture among Authors. This Opening is of no Disadvantage to them, but evidently would have been to us, for from the Weight of our *Viscera* and our continually gravitating upon these

Vasa Spermatica.

Whence
the false
Notion of
Hernia or
Rupture.

these Holes, we must have perpetually laboured under *Enterocetes*; this they are in no Hazard of, since in them this Passage is at the highest Part of their Belly, and in their horizontal Posture, the *Viscera* cannot bear upon it: And to prevent even the smallest Hazard, there is a loose pendulous Semilunar Flap of Fat which serves two Uses, as it both hinders the *Intestines* from getting into the Passage, and also the Course of the Fluids from being stopped in the Vessels, which is secured in us by the cellular Substance and tense *Peritoneum*.

The *Septum Medium*, or Conjunction of the two *Tunics*, is the same as in Men. There is next a Passage quite down into the Cavity, where the *Testicles* lye. Had the same Structure obtained in Man by the constant drilling down of the Liquor which is secreted for the lubricating of the Guts, we should always have laboured under an *Hydrocele*; but their Posture secures them from any Hazard of this kind; indeed

indeed your very fat Lap-dogs, who consequently have an overgrown *Omentum*, are sometimes troubled with an *Epiplocele*.

The *Scrotum* is shorter and not so pendulous as the Human, this it has in common with all the Dog Kind that want the *Vesiculæ Seminales*, who have it pretty close tucked up, that the Seed at each Copulation might the sooner be brought from the *Testes*, thus in some Measure supplying the Place of the *Vesiculæ Seminales*; for the course of the Seed through the *Vasa Deferentia* is thus shortened by placing the secerning Vessels nearer the Excretory Organs. This at the same Time explains the Reason why this Creature is so tedious in Copulation.

The Structure of the *Testicles* is much the same with the Human; as are likewise the *Corpus Pyramidale Varicosum* or *Pampiniforme*, and the *Epididymis* or Excretory Vessel of the *Testicle*; the *Vasa Deferentia* enter

the *Abdomen* where the Blood Vessels come out, and passing along the upper Part of the Bladder, are inserted a little below the bulbous part of the *Urethra*.

Penis.

The *Præputium* has two Muscles fixed to it ; one that arises from the *Sphincter Ani*, and is inserted all along the *Penis*, and this is called *Retractor Præputii*, but the other, whose Office is directly contrary to this, is cutaneous, and seems to take it's Origin from the Muscles of the *Abdomen*, or rather to be a Production of their *Tunica Carnosa*. The *Corpora Cavernosa* rise much in the same way as the Human, but these soon terminate, and the rest is supplied by a triangular Bone in the inferior Part of which there is a Groove excavated for lodging the *Urethra*. There are upon the *Penis* two protuberant bulbous fleshy Substances, at the back of which are two Veins, which by the *Erectores Penis* are compressed in the Time of Coition, and the Circulation being stopt, the Blood distends the large cavernous Bodies :
After

After the *Penis* is thus swelled, the *Vagina*, by it's Contraction, gripes it *Coitus* closely, and so the Male is kept in Action some Time contrary to his Will; till Time be given for bringing a Quantity of Seed sufficient to impregnate the Female; and thus by that *Orgasmus Veneris* of the female Organs, the want of the *Vesiculæ Seminales* are in some Measure supplied. But as it would be a very uneasy Posture for the Dog to support himself solely upon his hinder Feet, and for the Bitch to support the Weight of the Dog for so long a Time; therefore as soon as the bulbous Bodies are sufficiently filled, he gets off and turns averse to her; had then the *Penis* been pliable as in other Animals, the *Urethra* must of Necessity have been compressed by this twisting, and consequently the course of the Seed intercepted; but this is wisely provided against by the *Urethra's* being formed in the hollow of the Bone. After the Emission of the Seed, the Parts turn flaccid, the Circulation is restored, and the bul-

bous Parts can be easily extended.

Prostrata. The *Prostrata* seems here divided into two, which are proportionably larger than the human, and afford a greater Quantity of that Liquid.

Uterus. The *Uterus* of *Multifarious* Animals is little else but a Continuation of their *Vagina* only separated from it by a small Ring or *Valve*. From the *Uterus* two long Canals mount upon the Loins, in which the *Fætus's* are lodged; these are divided into different *Sacs*, which are strongly constricted betwixt each *Fætus*, yet these Coactions give Way in the Time of Birth. From these go out the *Tubæ Fallopiæ*, so that the *Ovaria* come to lodge pretty near the Kidneys.

*Dia-
phragm.*

We ought next to examine the Structure of the *Thorax* and it's Contents; but first it may not be amiss to remark of the *Diaphragm* in it's natural Situation, that it is in general more loose and free than the human, which

which is owing to it's Connection with the neighbouring Parts in a different manner from ours ; the human *Diaphragm* is connected to the *Pericardium*, which again by the Intervention of the *Mediastinum* is tied to the *Sternum*, *Spine*, &c. but here there is some Distance between the *Diaphragm* and *Pericardium*. We observe further that it's middle Part is much more moveable, and the tendinous Parts not so large. And indeed it was necessary their *Diaphragm* should be somewhat loose, they making more use of it in difficult Respiration than Man. This we may observe by the strong heaving of the Flanks of an Horse or Dog when out of Breath ; which corresponds to the rising of the Ribs in us.

The Disposition and Situation of the *Thorax*.
Mammæ vary as they bear one or more *Mammæ*.
 young. Those of the uniparous Kind have them placed between the posterior Extremities which in them is the highest Part of their Bodies, whereby their young get at them without the

Inconvenience of kneeling; nevertheless, when the Creatures are of no great Size, and their Breast large as in Sheep, the young ones are to take this Posture. In multifarious Animals they must have a great number of Nipples, that their several young ones may have room at the same Time, and these disposed over both *Thorax* and *Abdomen*; and the Creatures generally lye down when the young are to be suckled, that they may give them the most favourable Situation. From this it does not appear to be from any particular Fitness of the Vessels at certain Places, for giving a proper Nourishment to the Child, that the Breasts are so placed in Women, as we find them, but really from that Situation being the most convenient, both for Mother and Infant.

*Sternum,
Cistæ.*

The *Sternum* is very narrow, and consists of a great number of small Bones, moveable every Way, which always happens in Creatures that have a great Mobility in their *Spine*. The
 Ribs

Ribs are streighter and by no Means so convex as the human, whereby in Respiration the Motion forward will very little enlarge their *Thorax*, which is compensated by the greater Mobility of their *Diaphragm*: so our *Thorax* is principally enlarged according to it's Breadth and Depth, and theirs according to it's Length. The want of *Clavicles* and the consequent falling in of the anterior Extremities upon the Chest, may contribute somewhat to the Streightness of the Ribs.

The *Mediastinum* in this Creature *Mediastinum.* is pretty broad, whereas the human being so narrow has occasioned a Dispute whether there be such a Thing or not. The *Pericardium* is not here contiguous to the *Diaphragm*, but there is an Inch of Distance betwixt them, in which Place the small Lobe of the Lungs lodges, and by this Means the Liver, &c. of this Animal, though continually pressing upon the *Diaphragm*, yet cannot disturb the Heart's Motion.

Cor.

The Heart is situated with it's Point almost directly downwards, according to the Creature's Posture, and is but very little inclined to the Left-side. It's Point is much sharper, and it's Shape more Conoidal than the human. Here the Names of right and left *Ventricles* are proper enough, though not so in the human, which ought rather to be called anterior and posterior, or superior and inferior. The Animal has the *Vena Cava* of a considerable Length within the *Thorax*, having near the whole length of the Heart to run over ere it gets at the *Sinus Lowerianus Dexter*. In Men, as soon as it pierces the *Diaphragm*, so soon it enters the *Pericardium*, which is firmly attached to it, and immediately gets into the *Sinus Lowerianus*; which *Sinus* in the human Subject, by the oblique Situation of the Heart, is almost contiguous to the *Diaphragm*, and by this we discover that several Authors have taken their Delineations of the human Heart from Brutes, which is easily

*Vena
Cava.*

easily detected by the Shape and Situation of the Heart, and long *Vena Cava* within the *Thorax*. This was one of the Faults of the curious Wax-Works, that were shewn at *London* and *Paris*, which was plainly taken from a Cow.

This Situation of the Heart of the Creature agrees best with the Shape of it's *Thorax* which is lower than the *Abdomen*.

The Egress of the large Blood-Vessels from the Heart is somewhat different from the human, for here the left *Subclavian* comes off first, and then a large Trunk runs some way upwards before it gives off the left *Carotid*, and splits into the *Carotid* and *Subclavian* of the Right-side: So that neither here, properly speaking, is there an *Aorta ascendens*, more than in the human, but this Name has probably been imposed upon it from observing this in a Cow, where indeed there is an ascending and descending *Aorta*.

Aorta ascendens
improperly
so called.

From

From this Speciality of the Distribution of the Vessels of the Right-side, which happens, though not in so great a Degree, in the human Subject, we may perhaps in some Measure account for the general greater Strength, Readiness or Faculty of Motion, which is observable in the Right-Arm. I believe upon measuring the Sides of the Vessels, the Surface of the united Trunk of the right *Subclavian* and *Carotid* is less than that of the left *Subclavian* and *Carotid*, as they are separated; if so, the Resistance to the Blood must be less in that common Trunk, than in the left *Subclavian* and *Carotid*; but if the Resistance be smaller, the absolute Force with which the Blood is sent from the Heart being equal, there must necessarily be a greater Quantity of Blood sent through them in a given Time: And as the Strength of the Muscles is, *cæteris paribus*, as the Quantity of Blood sent into them in a given Time, those of the Right-Arm will be stronger than those

A Mechanical Account of the superior Strength of the Right-arm, Leg, &c.

of the Left. Now Children being conscious of this superior Strength, use the Right upon all Occasions, and thus from Use comes that great Difference which is so observable. That this is a sufficient Cause seems evident from Fact; for what a Difference is there betwixt the Right and the Left-Arm of one, who has played much at Tennis? View but the Arms of a Blacksmith, and Legs of a Footman, and you'll soon be convinced of this Effect arising from using them. But if by any Accident the Right-Arm is kept from Action for some Time, the other from being used gets the better, and those People are Left-handed: For it is not to be imagined that the small Odds in the original Formation of the Vessels should be sufficient to resist the Effect of Use and Habit, (Instances of the contrary occur every Day;) 'tis enough for our present Argument, that where no Means are used to oppose it, the Odds are sufficient to determine the Choice in favour of the Right. Now because it's natural to begin with the
Leg

Leg corresponding to the Hand we have most Power of; this is what gives also a Superiority to the Right-Leg.

This Difference is not peculiar to Man, but is still more observable in those Creatures, in whom the same Mechanism does obtain in a greater Degree. Do but observe a Dog at a Trot, how he bears forwards with his Right side, or look at him when a scraping up any Thing, and you will presently see that he uses his Right much oftner than he does his Left-Foot. Something analogous to this may be observed in Horses.

Thymus.

*Glandula
Thyroidea.*

The *Thymus* of this Creature is proportionably much larger than ours, whereas the *Glandula Thyroidea* is much less, and it's generally remarked that these two Glands do thus always supply the Place of each other: That is, in such Animals as have a large *Thymus*; the *Glandula Thyroidea* is smaller, and *vice versa*. Hence we are naturally
led

led to ascribe the same Use to both, viz. the Separation of a thin *Lymph* for diluting the *Chyle* in the *Thoracic Duct*, before it be poured into the Blood; then if we consider the different Formation of the *Thorax* in both, we shall readily account for the Variety in the Bulk of these two Glands. Respiration being chiefly performed in Man by the widening of the Chest, the Lungs at every Inspiration must press upon the *Thymus*, and consequently diminish it; but the *Diaphragm* yielding more in the Dog's Inspiration, this Gland is not so much pressed by the Lungs and so will be larger, and hence the *Glandula Thyroidea* will be proportionably less: Again, from the Posture of this Creature we shall see that it was much more convenient for a Dog to have the most Part of the diluting *Lymph* supplied by the *Thymus*, since the Neck being frequently in a descending Posture; the *Lymph* of the *Thyroid* Gland would have a very disadvantageous Course to get to the *Thoracic Duct*: whereas in the

the human Body, the *Thymus* is really below the *Lacteal* Canal, where it makes it's Curvature, before it opens into the *Subclavian*, and consequently there is a Necessity of a considerable Share of the diluting Liquor being furnished by the *Thyroid* Gland, which is situated much higher, so that it's *Lymph* has the Advantage of a perpendicular Descent.

*Ductus
Thoracicus.*

We may here observe that the *Thoracic Duct* in a Dog has no Curvature before it enters the *Subclavian* Vein. The horizontal Position of this Animal allowing a favourable enough Course to the *Chyle*, so as not to need that Turn to force it's Passage into the Blood. The Lungs of this Creature are divided into more numerous Lobes and deeper than they are in Man, for the same Reason as the Liver. The Left-side of the *Thorax* in this Animal bears a greater Proportion to the Right than in Man, the one being nearly as three to two, the other as four to three.

We

We look on it as a general Rule, *Neck.*
that all *Quadrupeds*, as having Occasion to gather their Food from the Ground, are provided with longer Necks than Man; but as a long Neck not only gives the Advantage of too long a *Lever* to the Weight of the Head, but also when the Animal is gathering his Food, makes the Brain in Danger of being oppressed with too great a Quantity of Blood, by the Liquor in these Arteries having the Advantage of a Descent, while that in the Veins must remount a considerable Way contrary to it's own Gravity, it was therefore necessary that a Part of the length of the Neck should be supplied by the length of the Jaws. *Jaws.*
Thus we see Horses, Cows, &c. who have no Occasion for opening their Mouths very wide, yet have long Jaws. Bull Dogs indeed, and such Animals as have Occasion for very strong Jaws, must of Necessity have them short; because the longer they are, the Resistance to be overcome acts with a longer

Teeth.

longer *Lever*. Another Exception to this general Rule, is, such Animals as are furnished with something analogous to Hands to convey their Food to their Mouths, as Cats, Apes, &c. The *Teeth* of this Creature plainly shew it to be of the *Carnivorous* Kind, for there are none of them made for grinding their Food, but only for tearing and dividing it. Even it's posterior *Teeth* are not formed with rough broad Surfaces as ours are; but are made considerably sharper, and press over one another when the Mouth is shut; that so they may take the firmer hold of whatever comes betwixt them.

Tongue.

The Tongue in Consequence of the length of the Jaws, is much longer than ours; and as this Creature feeds with his Head in a depending Posture, the *Bolus* would always be in Danger of falling out of the Mouth, were it not for several *Prominences* placed mostly at the Root of the Tongue, and crooked Backwards in such a Manner, as to allow any Thing to press easily

easily down to the Jaws ; but to hinder it's Return. In some Animals who feed on living Creatures, these under Hooks are still more conspicuous, as in several large Fishes, where they are almost as large as their *Teeth* in the Forepart of their Mouth, and near as firm and strong.

When we open the Mouth, we *Amygdalæ.* see the *Amygdals* very prominent in the posterior Part of it, so that it would appear at first View, that these were inconveniently placed, as being continually exposed to Injuries from the hard Substances this Creature swallows ; but upon a more narrow Scrutiny we find this provided for by two *Membranous Capsulæ*, into which the *Amygdals*, when pressed, can escape and remove themselves from such Injuries.

The *Velum Pendulum Palati*, is *Volum Pendulum Palati.* in this Creature considerably longer than in Man, to prevent the Food from getting into his Nose ; which would happen more frequently in this
E Animal

Comparative Anatomy.

Animal than in Man, because of it's Situation while feeding.

*Glottis.
Epiglottis.*

In this Subject there is no *Uvula*, but then the *Epiglottis*, when prest down, covers the whole *Rima* entirely and naturally continues so ; there is therefore a *Ligament* or rather *Muscle* that comes from the *Os Hyoides* and Root of the Tongue that is inserted into that Part of the *Epiglottis*, where it is articulated with the *Cricoid Cartilage* which serves to raise it from the *Rima*, though not so strongly but that it may with a small Force be clapt down again. If then in all such Animals as have no *Uvula*, the *Epiglottis* is so ordered as to be capable of covering the *Rima* entirely, and if in Man the *Epiglottis* cannot be so prest backwards and downwards, as to shut up the *Glottis* perfectly, but leaves a Space that can be exactly filled up by the *Uvula*, we may very reasonably conclude that the Use of this Part is to supply this Deficiency in the *Epiglottis*.

*The Use
of the U.
vula in
Man.*

In

In the upper Part of the *Pharynx*, behind the *Cricoid Cartilage*, there's a pretty large Gland to be found, which serves not only for the Separation of a *Mucous Liquor*, to lubricate the *Bolus* as it passes this Way, but also supplies the Place of a *Valve*, to hinder the Food from regurgitating into the Mouth, which it would be apt to do by reason of the descending Situation of the Creature's Head.

The *Oesophagus* is formed pretty much in the same Way as the human; Authors indeed generally alledge, that *Quadrupeds* have their Gullet composed of a double Row of *Spiral Fibres* decussing one another, but this is proper to ruminating Animals, who have occasion for such a Decussation of *Fibres*. The Action of these you may easily observe in a Cow chewing her Cud.

The Nose is generally longer than in Man, and it's external Passage much

Organ of
Smell.

narrower. The Internal Structure is also better adapted for an acute Smelling, having a larger convoluted Surface on which the *Membrana Scheideriana* is spread, and this is to be observed in most *Quadrupeds*, who have the *Ossa Spongiosa* commonly large, and these too divided into a great number of excessively fine thin *Lamellæ*. The Elephant, which has a Head pretty large in Proportion to it's Body, has the greatest Part of it taken up with the Cavity of the Nose and *frontal Sinusses*, which last extend almost over their whole Head, and leaves but a small Cavity for their Brains. A very nice Sense of Smelling was not so absolutely necessary for Man, who has Judgment and Experience to direct him in the Choice of his Food; whereas Brutes who have only their Senses, must have these of Necessity acute, some having one Sense in greater Perfection than others, according to their different Way of Life. We not only conclude *a priori* from the large expanded *Membrana Scheideriana*

riana that their Sense of Smelling is very acute, but we find it so by Cows, and Horses, distinguishing so readily betwixt noxious and wholesom Herbs, which they do principally by this Sense.

The external Ear in different *Qua-* *Auris.*
drupeds is differently framed, but always calculated to the Creature's manner of Life : In Shape it commonly resembles the oblique Section of a *Cone* from near the *Apex* to the Basis. Hares and such other Animals as are daily exposed to Insults from Beasts of Prey, have large Ears directed backwards, their Eyes warning them of any Danger before ; rapacious Animals, on the other Hand, have their Ears placed directly forwards, as we see in the Lion, Cat, &c. The slow Hounds and other Animals that are designed to hear most distinctly the Sounds coming from below, have their Ears hanging downwards. Man again, who must equally hear Sounds coming from all Quarters, but especially such as are sent from about his own Height, has

his external Ear placed in a *Vertical* manner, somewhat turned forward. In short, wherever we see a Speciality in the Make of this Organ in any Creature, we shall with very little Reflection discover this Form to be more convenient for that Creature than another. There are some Differences to be observed in the Structure of the internal Ear, in different Animals; but we know so very little of the Use of the particular Parts of that Organ in the human Subject, that it's altogether impossible to assign Reasons for these Variations in other Creatures.

*Membrana
Nictitans.*

All *Quadrupeds* have at the internal *Canthus* of the Eye, a strong firm *Membrane* with a *Cartilaginous* Edge, which may be made to cover some Part of their Eye, and this is greater or less in different Animals, as their Eyes are more or less exposed to Dangers in searching after their Food: this *Membrana Nictitans*, as it is called, is not very large in this Animal; Cows, and Horses have it so large as to cover
one

one half of the Eye like a Curtain, and at the same Time is transparent enough to allow Abundance of the Rays of Light to pass through it; Fishes have a *Cuticle* always over their Eyes as they are ever in Danger in that inconstant Element. In this then we may also observe a sort of Gradation.

All *Quadrupeds* have a seventh Muscle belonging to the Eye called *Suspensorius*. ^{*Musculus Suspensorius.*} It surrounds almost the whole *Optick Nerve*, and is fixed into the *Sclerotic Coat* as the others are; it's Use is to sustain the Weight of the Globe of the Eye, and prevent the *Optick Nerve* being too much stretched, without obliging the four straight Muscles to be in a continual Contraction, which would be inconvenient. At the same Time this Muscle may be brought to assist any of the other four, by causing one particular Portion of it to act at a Time.

Pupilla.

The next Thing to be remarked, is the Figure of the Pupil, which is different in different Animals, but always exactly accommodated to the Creature's Way of Life. Man has it circular for obvious Reasons, an Ox has it transverse, to take in a larger View of his Food ; Cats again have theirs somewhat perpendicular, (but can alter it pretty much) for a similar Reason, and so of the rest : The Pupil of different Animals varies in Wideness according as the internal Organs of Vision are more or less acute ; thus Cats and Owls who seek their Prey in the Night, or in dark Places (and consequently must have their Eyes so formed as that a few Rays of Light may make a lively Impression on the *Retina*) have their Pupils in Day-time contracted into a very narrow Space, as a great Number of Rays would oppress their nice Organs, while in the Night they dilate considerably. In the same Way when the *Retina* is inflamed, a great number of Rays of

Light

Light would occasion a painful Sensation; therefore the Pupil is contracted; on the contrary in dying People, or in a beginning *Amaurosis* it is greatly dilated, as the Eyes on such Occasions are very difficultly affected, and as it were insensible.

The posterior Part of the *Choroid* Coat, which is called *Tapetum*, is of *Tapetum*. different Colours in different Creatures: Or Oxen feeding mostly on Grass have this *Membrane* of a green Colour, that it may reflect upon the *Retina* all the Rays of Light which come from Objects of that Colour, while other Rays are obscured: Thus the Animal sees it's Food better than other Objects. Cats and Owls have their *Tapetum* of a whitish Colour, and for the same Reasons have the Pupil very dilatable; and their Organs of Vision acute; and we shall find that all Animals see more or less distinctly in the Dark, according as their *Tapetum* approaches nearer to a white or black Colour. Thus Dogs who have it of a greyish Colour

Colour distinguish Objects better in the Night than Man, whose *Tapetum* is dark brown, and who I believe sees worst in the Dark of any Creature : it being originally designed that he should rest from all Kinds of Employments in the Night-time. The Difference then of the Colour of the *Tapetum*, as indeed the Fabrick of any other Part in different Creatures, always depends on some particular Advantage accruing to the Animal in it's peculiar manner of Life from this Singularity.

Cerebrum.

We shall now proceed to the Brain, which we remark in the first Place is proportionally much smaller in all *Quadrupeds* than the human. The Reason of which may be, that as those Creatures for the most Part seek their Food with their Heads in a depending Posture, this Situation would make it very inconvenient for the Brain itself to send it's Animal Spirits (or it's Influence and Energy, let that be what it will) through the Nerves, so that

it

it was necessary they should be supplied from somewhere else, and consequently there was no Reason for the Brain itself being of a great Bulk. As a Confirmation of this Theory, we find that the *Intercostal* and eight Pair of Nerves, which serve the vital Organs in the human Body, take their Origin from the *Encephalon*, which in *Quadrupeds* come mostly from the *Theca Vertebrarum*. Again there was no such Occasion for so great a Quantity of Brains in those Animals as in Man; seeing in them all it's Energy is employed in their Progression, while Man has a great Waste of Spirits in the Exercise of his Reason and Intellectual Faculties. And besides all this, a great bulky Brain would be inconvenient to these Creatures in so far as it would add considerably to the Weight of the Head, which having the Advantage of a long *Lever* to act with, would require a much greater Force to support it, than now it does; for the Heads of the greatest Parts of *Quadrupeds* are not near so heavy

heavy as they would at Sight seem to be from the *Sinus Frontales*, being produced a great way upwards to enlarge the Organs of Smelling.

The Pits in the anterior Part of their Skulls are much more conspicuous than in the human *Cranium*, which may be occasioned by the depending Posture of these Creatures Heads, while they gather their Food: The Brain at this time gravitating much on the Bones while they are as yet soft, will gradually make Impressions upon them at these Places where it rises into Eminencies. This is prevented in Man mostly by his erect Posture.

Falx.

The *Falx* is not near so large in *Quadrupeds* as in Man, as they have little Occasion to be on either Side, and the two *Hemispheres* of the Brain are in a great Measure hindered from justling against one another in violent Motions, by the Brain's insinuating itself into the above-mentioned Pits.

The

The second Process of the *Dura Mater*, or *Tentorium Cerebelli Superexpansum* is considerably thicker and stronger in most *Quadrupeds* than in Man, especially in such of them as are very swift of Foot, as Hares and Rabbits, and that most when they are old. This Membrane is generally ossified, that it may the more effectually keep off the Weight of the superincumbent Brain from the *Cerebellum* in their rapid Motions, which otherwise would be of bad Consequence.

The olfactory Nerves are very large, and justly deserve the Name of *Processus Mamillaris*. They are hollow and consist of a *medullary* and *cineritious* Substance, and at first Sight appear to be anterior Ventricles of the Brain produced; but in Man they are small, and without any discernable Cavity. The Reason of this is pretty evident, if we consider how this Animal's Head is situated; for the *Lymph* continually gravitating upon the inferior

Processus Mamillaris.

Part

Part of the *Ventricles* may thus elongate and produce them : But from this very inferior Part the *Olfactory Nerves* rise, and are sent immediately through the *Os Ethmoides* into the Nose. Hence the Ancients thinking they were continued hollow into the Nose, believed they were the *Emunctories* of the Brain ; in the Brain of Sheep, which by its firm Texture is the best Subject of any for searching into the Structure of this Part, we evidently see, that the Name of the *Sigmoid Cavities* was very properly applied by the Ancients to the lateral Ventricles of the Brain, which are really of a greater Extent than they are ordinarily painted by the Anatomists, reaching farther backwards and forwards again under the Substance of the Brain.

Nates.
Testes.

The *Nates* and *Testes* deserve this Name much better here than in the human Body with respect to each other. They are here also of different Colours, the *Nates* being of the Colour

of

of the *Cortical*, and the *Testes* of the *Medullary* Substance of the Brain: Whereas in Man they are both of one Colour. The Reason of these Differences, and others of the like Nature to be met with, I shall not pretend to determine; for we have hitherto such an imperfect Knowledge of the Brain itself, that we are entirely ignorant of the various Uses of it's different Parts; we may in general conclude, that the varying in one Animal, from what it is in another, is fitted to the Creature's particular Way of living.

The *Rete Mirabile Galeni*, situated on each Side of the *Sella Turcica*, about which there has been so much Dispute, is more remarkable in *Quadrupeds* than in the human Subject, though it's certainly to be found there too; notwithstanding several Anatomists have denied it's Existence. The Use indeed which *Galen* ascribes to it is frivolous, and not well grounded; for he will have this *Plexus* of Vessels serve for checking the Impetuosity of the Brain, but

Rete Mirabile Galeni.

it is evident this cannot be the Use of it; if indeed the whole *Carotid Artery* had split into such small Vessels as compose this Network, the Motion of the Blood would certainly have been retarded in it; but this is not the Case, for it only sends off a few small Twigs to compose the *Plexus* at its entry into the *Cranium*, and the Branches going out from this same *Plexus*, are distributed to the neighbouring Nerves: Among the rest it gives some Twigs to the *Ophthalmic* Branch of the fifth Pair. It is this Distribution of these Arteries makes it so difficult to determine whether there is a Communication between the *Intercostal* and that Nerve; for if you dissect the Parts in a recent Subject, you would at first view affirm, that there is an *Anastomosis*; but when the *Carotid Artery* is injected, and the *Plexus* filled with the subtile Liquor, these Branches, which formerly seemed to be Nerves, have now the Appearance of Arteries by the Vessels of their Coats being injected. I have been at great Pains to enquire

enquire into the Matter, but could never positively determine if there is such an *Anastomosis* as is described by a great many Authors, and so very distinctly delineated by Dr. *Lower* in *Willis's* Treatise of the Nerves, and by Mr. *Vieussen*, only it seems most probable from the Sympathy observable between them that there is such an *Anastomosis*.

The Structure of the Brain differing but very little in all *Quadrupeds*, it will be needless to examine it in any other.

The Anatomy of a Cow.

THE next Species of *Quadrupeds* we proposed to consider was the ruminant Kind, of which we have an Example in a Cow, and accordingly shall take the *Fetus* of the Animal in *Utero*, that we may first remark some Things that are peculiar to it in that State, and afterwards proceed to examine it's *Viscera* as a ruminant Animal; first then as a *Fetus*.

F

The

Uterus.

*Cornua
Uteri.*

The Form of a Cow's *Uterus* differs from the Human, in having two pretty large *Cornua*. This is common to it with other Brutes, for a Bitch has two long *Cornua Uteri*; but these again differ (as being *Multiparous* and *Uniparous*) in this, that in the Bitch's *Cornua* the *Fætus's* are contained, whereas here there is only Part of the *Secundines*, being mostly the *Allantois* with the included Liquor. The muscular Fibres of the *Uterus* are more easily discovered; it's internal Surface has a great Number of spongy, oblong, protuberant, glandular Bodies fixed to it by a fine *Membrane*: These are composed of the several large Vessels of the *Uterus* terminating here. These are very small, and sometimes not to be observed at all. In an impregnated *Uterus*, we can easily press out of them a *Chylous Mucilaginous* Liquor; they are composed of a great many Processes or *Digituli*, and deep Caverns answering to as many Processes and Caverns of the *Placenta*. Their Resemblance

Resemblance has occasioned the Name of *Papillæ* to be given them, and hence it was that *Hippocrates* was induced to believe, that the *Fætus* suck'd in *Utero*. It is not easy to determine, whether the *Uterus* grows thicker or thinner in the Time of Gestation. The *Membranes* it is plain (by the stretching of the Parts) must be made thinner, but then it is as evident, that the Vessels are at that Time enlarged, upon which principally the Thickness of any Part depends; so there seems to be as much gained the one Way, as lost the other. The *Os Uteri* is entirely shut up by a glutinous mucilaginous Substance, that is common to the Females of all Creatures when with young; by this the external Air is excluded, which would soon make the Liquors corrupt, it also prevents the Inflammation of the *Membranes*, and the Hazard of Abortion. By this Means also the Lips of the Womb are kept from growing together, which otherwise they would certainly at this time do. There are *Mucous* Glands placed here to secrete

*Uterus is
thicker in
time of
Gestation.*

Comparative Anatomy.

this *Gluten*, which on the breaking of the *Membranes* with the contained Waters make a *Sapo* that lubricates and washes the Parts, and makes them easily yield. The first of the proper *Involucra* of the *Fœtus* is the *Chorion*.

Chorion.

The *Chorion* is a pretty strong firm *Membrane*, on whose external Surface are dispersed a great many red fleshy Bodies of the same Number, Size and Structure with the *Papillæ*, with which they are mutually indented. They have been called *Cotyledones* from *Korónē* Cavity. This is greatly disputed by some as a Name very improper, but I think without Reason, since the Surface that is connected to the *Papillæ* is concave, though when separated it appears rather convex. To shun all Dispute, they may be called properly enough *Placentulæ*, since they serve the same Use as the *Placenta* in Women. The Separation of these from the *Papillæ* without any Dilaceration seems to prove beyond a Reply, that there can be here no *Anastomoses* betwixt the Vessels;

Cotyledones.

on

on their Coats run a great Number of Vessels that are sent to the several *Placentulae*, on the external Side next to the *Uterus*; whereas in Creatures that have but one *Placenta*, as in the human Subject, Cats, Dogs, &c. the Adhesion is somewhat firmer: The *Placentae* are likewise joined to the *Papillae* in the *Cornua Uteri*. We shall next give the History of the *Allantois*.

This is a fine transparent *Membrane* *Allantois*. contiguous to the former. It is not a general *Involucrum* of the *Fœtus* in the Mother, for it covers only a small Part of the *Amnios*: It is mostly lodged in the *Cornua Uteri*. In Mares, Bitches and Cats it surrounds the *Amnios*, being every where interposed betwixt it and the *Chorion*. In Sheep and Goats it is the same as in this Animal; and in Swine and Rabbits it covers still less of the *Amnios*. This Sac is probably formed by the Dilatation of the *Ura-chus*, which is connected at it's other End to the *Fundus* of the Bladder, through which it receives it's Contents,

and the *Membrane* is doubled at the Extremity of the Canal to hinder the Return of the Urine back into the Bladder. It's Vessels are excessively fine and few, and we cannot force an injected Liquor farther than the Beginning of this Coat. This *Membrane* is so far analogous to the *Cuticula*, as not to be liable to Corruption, or easily irritated by acrid Liquors. The Existence of this *Membrane* in Women has been very warmly disputed on both Sides: Those who are against it's Existence deny they could ever find it, and allowing it were so, alledge, that since the *Urachus* is impervious, as appears by our not being able to throw Liquors from the Bladder into it, or *Vice Versa*, it cannot serve the Use, that is agreed by all it does serve in Beasts, and therefore in the human Body there is no such thing: But if we consider on the other Hand, that first there seems to be the same Necessity for such a Reservoir in Man, as in other Animals. Secondly, That we actually find Urine contained in the Bladder of
the

*The Arguments for
and against
the human
Allantois.*

the human *Fœtus*. Thirdly, That Urine has been evacuated at the Navel when the *Urethra* was stopped, which Urine without this Conduit would have fallen into the Cavity of the *Abdomen*. Fourthly, that Midwives do generally remark two different Sorts of Waters come away at the Time of Birth; and lastly, That Dr. *Littre* and Dr. *Hale* have given in this *Membrane* of an human Subject with all the other *Secundines* curiously prepared, the one to the Royal Academy at *Paris*, the other to the Royal Society at *London*, by which Societies their respective Accounts are attested, not to mention *Verheyen*, *Heister*, *Keil*, &c. who affirm their having seen it, and Mr. *Albinus*, that famous Anatomist, Professor at *Leyden*, shows, as I am told, to his College every Year a Preparation of it. On all these Accounts I must own, that it seems most probable to me there is such a *Membrane* in the human Body, although in four Bodies I purposely dissected, wherein I was assisted by a very accurate Anatomist, Dr. ~~Sawyer~~, I

Then

F 4

could

could not observe any such thing; however, I would rather accuse my own Want of Skill, than doubt the Truth of Relations supported by such authentic Vouchers.

Amnios.

The third proper Integument of the *Fœtus* is the *Amnios*; it is thinner and firmer than the *Chorion*; It has numerous Ramifications of the umbilical Vessels spread upon it, the lateral Branches of which separate a Liquor into it's Cavity. This is the proper Liquor of the *Amnios*, which at first is in a small Quantity, afterwards encreases for some Months, then again decreases; and in a Cow near her Time the Quantity of this Liquor is not above a Pound. This *Membrane* does not enter the *Cornua Uteri* in this Creature; but for what further relates to the Structure of the *Involucra*, with the Nature of the Liquors contained in them, I must refer to the second Volume of Medical Essays, from Page 121, where you have the Sum of all we know of this Matter.

Then

Then are here two *Vene Umbilicales*, and but one in the human Subject, because the extreme Branches coming from the several *Placentulae* could not unite, so soon, as they would have done had they come all from one Cake as in the Human.

There's a small round fleshy Body that swims in the Urine of this Creature, Mares, &c. called *Cuticula*, which is the *Hypomenes* of the Ancients. Several idle Opinions and Whims have been entertained as to it's Use, but that seems to be still unknown, or how it's generated or nourished, for it has no Connection with the *Fætus* or *Placentulae*.

Having thus considered the several *Involucra* of this Animal in a *Fætus* State, let us next observe the Specialties in it's internal Structure peculiar to a *Fætus*.

The

Vena Umbilicalis.

The umbilical Vein joins the *Vena Portarum* in the *Capsula Glissoniana* without sending off any Branches as it does in the human Subject. This Vein soon after Birth turns to a Ligament, yet there are some Instances where it has remained pervious for several Years after Birth, and occasioned an Hemorrhage. We may next observe the Duct

Canalis Venosus.

called *Canalis Venosus*, going straight from the *Capsula Glissoniana* to the *Vena Cava*; this turns also afterwards to a Ligament. The umbilical Arteries rise at acute Angles from the internal Iliacs, whatever some may say to the contrary; These also become impervious.

The pulmonary Artery coming from the right Ventricle of the Heart divides into two, the smallest called *Canalis Arteriosus* opens into the descending *Aorta*; the other divides into two, to serve the Lungs on each Side. The *Foramen Ovale* is placed in the Partition betwixt the right and left Auricles.

Foramen Ovale.

cles. At the Edge of this Hole is fixed a *Membrane*, which when much stretched will cover it all over, but more easily yields to a Force that acts from the right Auricle to the left, than from the left to the right; after what has been said we may easily understand how the Circulation is performed in a *Fœtus*. The Blood being brought from the *Placenta* of the Mother, is thrown into the *Capsula Glissoniana*, where it is intimately blended with the Blood in the *Vena Portarum*: then part of this Blood goes directly into the *Vena Cava* by the *Ductus Venosus*, the rest passes through the Liver. First then the whole is sent from the *Vena Cava* into the right *Auricle*, from whence part of it is sent by the *Foramen Ovale* into the left *Auricle*, the rest passes into the right Ventricle, then into the *Pulmonary Artery*, then the greatest Share it receives is sent immediately into the descending *Aorta* by the *Canalis Arteriosus* and the Remainder circulates through the Lungs and is sent back by the *Pulmonary Veins*

The Circulation, how performed in a Fœtus.

Veins into the left *Auricle*, which with the Blood brought there by the *Foramen Ovale* is sent into the left Ventricle, from whence it is driven by the *Aorta* through the Body. The great Design of this Mechanism is, that the whole Mass of Blood might not pass through the collapsed Lungs of the *Fœtus*, but that part of it might pass through the *Foramen Ovale* and *Canalis Arteriosus* without circulating at all through the Lungs.

*Messieurs
Mery and
Winflow,
their Opini-
ons of it
examined.*

This was the Opinion that universally prevailed till the End of the last Century, when it was violently opposed by Monsieur *Mery*, who is very singular in several of his Opinions. He will not allow that the *Foramen Ovale* transmits Blood from the right to the left *Auricle*, but on the contrary from the left to the right, and that for no other Reason but because he observed the *Pulmonary Artery* in a *Fœtus* longer than the *Aorta*: Mr. *Winflow* endeavours to reconcile these two Opinions, by saying the Blood may pass
either

either Way, and that it is here as it were blended; his Reason is, that on putting the Heart in Water, the *Foramen Ovale* transmits it any Way. Mr. *Robault*, Professor of Anatomy at *Turin*, and formerly one of *Mery's* Scholars, strongly defends his Master and criticises Mr. *Winslow*. What he principally builds on is the Appearance this *Foramen* has in some dry'd Preparations: This Mr. *Winslow* won't allow as a Proof. After all I remain in the common Opinion, and that for the following Reasons; first the *Pulmonary* Artery being larger signifies nothing, since it's Coats are not only thinner, and will be more easily distended, but also the Resistance to the Blood in the *Pulmonary* Artery from the collapsed Lungs is greater than the Resistance to the Blood in the *Aorta*. Secondly, if we should allow any of these two uncommon Opinions, we should have the right Ventricle vastly more capacious than the left; for if we suppose the *Foramen Ovale* to be capable of transmitting one half of the whole

whole Mass of Blood in any given Time, and the *Arteriosus* as much in the same Time, than you'll find that according to Mr. *Mery's* Opinion, the whole Mass of Blood being driven from the right Ventricle into the *Pulmonary* Artery, one third passes by the *Canalis Arteriosus* into the descending *Aorta*, two thirds passing through the Lungs and returning into the left *Auricle*, one half of it, or one third of the whole Mass passes by the *Foramen Ovale* into the right *Auricle*, and the other or the last third will be sent into the left Ventricle, and thence expelled into the *Aorta*, which third, with that from the *Pulmonary* Artery by the *Canalis Arteriosus*, circulating through the Body, are returned unto the right *Auricle*, where meeting with the other third from the *Foramen Ovale*, with it are sent into the right Ventricle, to undergo the same Course. Thus the whole Mass is expelled by the right Ventricle and only one third by the left. If this was the Case, why is not the right Ventricle three times

as large and strong as the left? Then if according to Mr. *Winslow's* System the *Foramen Ovale* transmits equal Quantities from both *Auricles*, this comes to the same as if there was no *Foramen Ovale* at all; that is to say, the whole Mass going from the right *Auricle* into the right Ventricle and *Pulmonary Artery*, one third of the whole Mass passes into the *Aorta* thro' the *Canalis Arteriosus*, the other two thirds passing through the Lungs return to the left Ventricle and *Auricle*, to be sent through the *Canalis Arteriosus* to the right Ventricle to undergo the same Fate; thus the right Ventricle expels the whole Mass, the left only one third; but if according to the common Opinion we suppose the *Foramen Ovale* to convey the Blood from the right to the left *Auricle*, then one third passes this Way into the left Ventricle, the other two thirds are sent by the right Ventricle into the *Pulmonary Artery*, from whence one third passes by the *Canalis Arteriosus* into the *Aorta descendens*, the other

4th third

third circulates through the Lungs and is returned into the left Ventricle, where meeting with that from the *Foramen Ovale* is with it expelled into the *Aorta*, and with the one third transmitted by the *Canalis Arteriosus* returns into the *Auricle* to run the same Race as before. Thus we conclude that two thirds are expelled by each Ventricle and the whole circulates thro' the Body; and hence they come to be of pretty equal Dimensions; in all this Calculation I have had no regard to the Blood discharged from the *Umbilical Vessels*, but the greater Quantity returned by the Veins, than sent out by the Arteries, still argues for the common Opinion.

The Kidneys.

The Kidneys in the *Fetus* are composed of different Lobes, which serves to give us an Idea of the Kidneys being a Congeries of different Glands; these Lobes being kept contiguous by the external *Membrane* are pressed by the other *Viscera* till at Length they unite.

We

We come now to consider the Creature as a ruminant Animal. There

are no *Dentes Incisores* in the Upper-Jaw, but the Gums are pretty hard, their Tongue rough, and they supply this Defect by wrapping their

The History of it as a ruminant Animal.

Tongue round a Tuft of Grass, so pressing it against the Upper-Jaw keep it stretched, and cut it with the Teeth of the Under-Jaw; then, without chewing, throw it down into the *Oesophagus*, which in these Creatures consists of a double Row of *Spiral Fibres* decussating one another. All Animals

which ruminate must have more Ventricles, than one, some have two, some three, our present Subject has no less than four. The Food is carried directly

It has four Stomachs.

down into the first, which lies upon the Left-side and is the largest of all; it is called *γαστήρ Ventriculus*, and *κοιλία* by way of Eminence. It is what is called by the general Name of Paunch by the Vulgar. There are no *Rugæ*

Their Names and Description.

upon it's internal Surface; the Food, by the Force of it's muscular Coat,

G

and

and the Liquors poured in here, is sufficiently macerated, after which it is forced up hence by the *Oesophagus* into the Mouth, and there it is made very small by Mastication; this is what is properly called Chewing the Cud or Ruminatio; after this it is sent down by the Gullet into the second, for the *Oesophagus* opens indifferently into both; however the Creature has a Power to direct it into which it will. Some tell us that the Drink goes into the second, but that might be easily determined by making them drink before Slaughter; the second Stomach, which is the anterior and smallest, is called κεράφαλλον *reticulum*, the *Bonnet*, or *King's-Hood*. It consists of a great Number of Cells on it's internal Surface of a regular *Pentagonal* Figure, like to a Honey-comb. Here the Food is farther macerated, from which it is protruded into the third called *Exivum* or *omasum*, vulgo the *Manyplus*, because the internal Surface rises up into a great many *Plicæ* or Folds, and *Stratum super Stratum*, according to the length

length of this Stomach. Some of these *Plicæ* are further produced into the Stomach than others, *i. e.* first two long ones on each Side, and within these, two shorter in the middle, &c. There are several Glands in this Stomach which is next to the *Koιλία* in Bigness, and from this it passes into the fourth, whose Names are *Ἐνυστρον* *abomasum*, *Caille*, or the *Red*, which is the name it commonly has because of it's Colour. *Caille* signifies curdled, and hence the *French* have given that as a Name to this fourth Stomach, because any Milk that is taken down by young Calves, from the long *Remora* it makes here, turns acid; and by the Remains of the Milk before taken down assisting, it is curdled. It is this fourth Stomach with the Milk curdled in it, that is commonly taken for earning of Milk (as they call it) but after the *Bile* and *Pancreatic* Juice enter, this Coagulation is not to be found, which shews the Use of these Liquors. There are other Creatures that use the same Food, that have not such a Mechanism

in their digestive Organs ; Horses, Affes, &c. have but one Stomach where Grass is macerated, and a Liquor for their Nourishment extracted, and the Remainder sent out by the *Anus* very little altered. From this different Structure of the Stomach in these Creatures, a ruminant Animal will be served with one third less Food than another of equal Bulk ; Graziers are sufficiently acquainted with this. The Reason is, that ruminating Animals have many and strong digestive Organs ; all their Food is fully prepared and almost wholly converted into *Chyle*, but a Horse's Stomach is not fitted for this, so that they require a much greater Quantity of Food to extract the same Nourishment.

Intestina.

The Guts of these Creatures are of a considerable length in Proportion to the Bulk of the Animal's Body, and this confirms what we said formerly on the Subject of the *Intestines* of a Dog, *viz.* that the Length and Capacity

capacity of the Guts were different in different Animals according to the Nature of their Food.

The *Duodenum* is formed here much *Duodenum.* the same Way as in a Dog, and the general Intention kept in View, with regard to the Mixture of the *Bile* and *Pancreatic Lymph*. The great Guts here hardly deserve that Name, their Diameter differing very little from that of the small ones; but to compensate this, they are much longer proportionally than a Dog's are, being convoluted in the same Way as the small Guts are. The *Cæcum* is very large,

The *Spleen* differs not much either *Spleen.* in Figure or Situation from that of a Dog's, but it is a little more firmly fixed to the *Diaphragm*, there not being here so much Danger of this *Viscus's* being hurt in the *Flexions* of the *Spine*.

The *Liver* is not split into so many *Liver.* Lobes in this Creature as either in a Man

Man or Dog, which depends on the small Motion this Creature enjoys in it's *Spine*, which made such a Division needless: This also confirms what I formerly advanced on this Head.

Bladder.

Their *Vesica Urinaria* is of a pyramidal Shape, and has scarce any *muscular Fibres*. It is very large and membranaceous, for the Urine of these Creatures not being so acrid as that of *carnivorous* Animals, there was no such Occasion for expelling it so soon.

Scrotum.

Vesiculæ

Seminales.

This Creature is provided with a loose pendulous *Scrotum*, and consequently with *Vesiculæ Seminales*. The Female Organs differ from those of a Bitch, mostly as to the Form of the *Cornua Uteri*, which are here converted in form of a Snail. In this and all uniparous Animals they contain only Part of the *Secundines*, but in Bitches and other multiparous Animals they run streight up in the *Abdomen*, and contain the *Fætus* themselves.

Cor.

The Situation of the Heart is pretty much

much the same with that of a Dog, only it's Point is rather sharper; in us the Heart beating continually against the Ribs, and both *Ventricles* going equally far down to the Constitution of the *Apex* it is very obtuse, but here the *Apex* is made up only of the left *Ventricle*, so is more acute.

The *Aorta* in this Creature is justly divided into ascending and descending, though this Division is ill founded either in a Dog or Man, and it has certainly been from this Subject that the older Anatomists took their Descriptions when they made this Division; for here the *Aorta* divides into two, the ascending and descending; the descending runs upwards or forwards according to their Posture for two or three Inches, before it gives off the left *Subclavian*, and still an Inch or more before the right *Subclavian* comes off, and yet somewhat further before it divides into the two *Carotids*, so that the Vessels that go to

Aorta ascendens and descendens.

the anterior Extremity of the Right side, do still keep longer in a common Trunk with the *Carotids* than those on the Left.

Of Fowls in General.

THE next Class of Animals we come to consider, are the feathered Kind; which are divided into the *Granivorous* and *Carnivorous*. But before we go on to consider the Specialties in the *Viscera* of each Kind, we must observe what both Species agree in.

Their Covering.

Fowls have a particular Covering of *Feathers* different from all other Creatures, but exactly well suited to their manner of Life; for it not only protects them from the Injuries of the Weather, but serves them in their Progression through that thin aerial Element, they are for the most Part employed in; and as some Fowls live much in the Water, their Feathers being continually besmeared with an oily Liquor, keeps the Water from soaking into their Skins, and so prevents

vents it's bad Effects, which it would infallibly otherwise produce.

Fowls have the strongest Muscles of their whole Body inserted into their Wings; whence by the Way we may observe that it is altogether impossible for Man to buoy himself up into the Air like Birds, even though he had proper Machines in place of Wings, unless he were likewise provided with Muscles strong enough for moving them, which he has not. In the next Place their Wings are not placed in the middle of their Bodies, but a good deal further forwards, whence it would at first View appear that their Heads would be erect, and their Posterior Parts most depending, when raised in the Air; but by stretching out their Heads, which act upon the Lever of a long Neck, they alter their Center of Gravity pretty much, and also by filling the Sacs or Bladders in the Inside of their *Abdomen*, with Air, and expanding their Tail, they come to make the Posterior Part of their Bodies

Their Wings, how furnished.

Why not placed in the middle of the Body.

dies considerably higher, and thus they fly with their Bodies near in an horizontal Situation. Hence we find, that if their Necks are kept from being stretched out, or if you cut away their Tails, they become incapable of flying any considerable Way. The Largeness of the Wings in different Fowls varies, according to the Occasions of the Creature. Thus Birds of Prey, who must fly a considerable Way to provide their Food, have large strong Wings; whereas domestic Birds, who find their Nourishment almost every where, have very short and but small Wings. The best Account of the manner of Progression of Fowls, is given by *Alfonfus Borellus*, in his Treatise *De Motu Animalium*, and in the *Religious Philosopher* we have *Borelli's* Doctrine stript pretty much of it's Mathematical Form. The Posterior Extremities are so situated as to make us at first think they would be in continual Hazard of falling down forwards when they walk, but this is prevented by their holding up their
Heads

Heads and Necks, and when they have occasion for climbing up a steep Place, they stretch out their Head and Necks forwards. Thus we may observe a Goose, entering a Barn-door, where generally there is an ascending Step, to stretch out it's Neck, which before was raised, and incline it's Body forwards; this is laughed at by the common People, who ascribe it to a piece of Folly in the Goose, as if afraid of knocking it's Head against the top of the Door.

Carnivorous Animals are provided with strong crooked Claws for the catching their Prey; Water Fowls use them for Swimming, and principally for this Purpose have a strong firm *Membrane* interposed betwixt the Toes; A peculiar Mechanism in the Toes of Fowls. there is a beautiful Mechanism to be observed in the Toes of Fowls, which is of considerable use to them; for their Toes are naturally drawn together or bended when the Foot is bended; this perhaps proceeds from the Tendons of the Toes passing over

4 in

in them, which is analogous to our Heels, and when the Foot is bended must consequently be much stretched; and since they are inserted into the Toes, must of Necessity bend them when the Foot is bended, and when the Foot is extended the *Flexors* of the Toes are again relaxed, and they therefore expanded. This is of great Use to Water Fowls, for had there been no such Contrivance as this, they must have lost as much Time when they pulled their Legs in, as they had gained by the former Stroke; but as the Parts are now framed, whenever the Creature draws in it's Foot, the Toes are at the same Time bended and contracted into less Space, so that the Resistance made against the Water is not near so great as before: On the contrary, when they stretch their Foot their Toes are extended, the *Membrane* betwixt them expanded, and consequently a greater Resistance made to the Water. Again, such Fowls as live mostly in the Air, or have occasion to sustain themselves on Branches of Trees
in

in windy Weather, and even in the Night-time when asleep, while all their Muscles are supposed to be in a state of Relaxation; such, I say, have no more to do, but lean down the Weight of their Bodies and their Toes continue bended without any Muscles being in Action; and whenever they would disentangle themselves, they raise up their Bodies, by which their Foot, and consequently their Toes, are extended.

Carnivorous Fowls have their Beaks long, sharp and crooked; the domestic Fowls, such as the Hen Kind, &c. have strong short Beaks, commodiously fitted to dig up and break their Food; the Water Fowls again have long or very broad Scoop-like Beaks, which is most convenient for them. The *Sternum* of Fowls is much larger proportionally than the Human, and has a Ridge rising in it's Middle for the more commodious Origin of the Muscles that move the Wings. It is also less moveable than ours, for

The Variety in the Beaks of Fowls. It's Uses, &c.

had

had it been very moveable, a great deal of the Force employed for moving the Wings would at every Contraction of the Muscles have been lost, or else some other Muscles must have come in Play to keep firm the *Sternum*, but this additional Weight would have been inconvenient for their Progression.

What other Things are most remarkable in the Structure of the several *Viscera*, we shall consider in that common domestic Animal, the Cock or Hen, and afterwards observe the Difference of their *Viscera Chylopoietica* from a *Carnivorous Fowl*.

The Anatomy of a Cock.

Oesophagus.
Ingluvies.

THE *Oesophagus* of this Creature runs down it's Neck somewhat inclined to the Right-side, and terminates in a pretty large *Membranous Sac*, which is the *Ingluvies* or Crop where the Food is macerated and dissolved by a Liquor, separated by the Glands which are easily observed

ed every where on the external Surface of this Bag. The Effect of this Maceration may be very well observed in Pigeons, who are sometimes in Danger of being suffocated by the Pease, &c. they feed upon, swelling to such an immense Bulk in their *Ingluvies*, that they can neither get upwards nor downwards. If it be a favourite Fowl, it might be preserved by opening the *Sac*, taking out the Pease and sewing up the Wound.

The Food getting out of this *Sac*, *Ventriculus Succenturiatus* goes down by the remaining Part of the *Oesophagus* into the *Ventriculus Succenturiatus* or *Infundibulum Peyerii*, *seu Infundibulum*, which is a Continuation of the Gullet with more numerous Glands which separate a Liquor to dilute the Food still more, which at Length gets into the true Stomach or Gizzard, which consists of two very strong Muscles covered externally with a *tendinous Aponeurosis* and lined on the Inside by a very thick firm *Membrane*, which we evidently discover to be a Production of the *Cuticula*.

licula. This might have been proved in some Measure a Priori, from taking Notice that this *Membrane*, which in Chicks is only a thin slight *Pellicle*, by Degrees turns thicker and stronger, the more Attrition it suffers : but there is no other Animal Substance, so far as we know, which grows more hard and thick by being subjected to Attrition,

Epidermis
invests the
internal
Surface of
all the Ca-
vities and
Vessels of
the human
Body.

excepting the *Cuticula*. Hence may be drawn some kind of Proof of what I have sometimes affirmed concerning the *Tunica Villosa* of the Stomach, and *Intestines* in the human Body, viz. that it was only a Continuation of the *Epidermis*. Nay, all the hollow Parts of the Body, even Arteries, Veins, &c. seem to be lined with a Production of this *Membrane* or one *Analogous* to it. The Use of this internal Coat of the Stomach of Fowls is to defend the more tender Parts of that *Viscus* from the hard Grains and little Stones those Creatures take down.

The Digestion of these Animals is performed merely by Attrition, as is

evinced by many Experiments. We see them daily take down considerable Numbers of the most solid rugged little Flints they find, and these can serve for no other Purpose than to help the Trituration of their Aliments. After these Pebbles by becoming smooth are unfit for this Office, they are thrown up by the Mouth; hence Fowls that are long confined, though never so well fed, turn lean for want of these Stones to help their Digestion; but this was put beyond all Dispute by Mr. *Tauvry*, who gave a Species of Metal to an Ostrich, convex on one Side, and concave on the other, but carved on both; and opening the Creature's Body some Time after, it was found that the carving on the convex Side was all obliterated, while the engraved Character remained the same as before on the concave Side which was not subjected to the Stomach's Pressure, which could not have happened had Digestion been performed by a *Menstruum*, or any other Way whatsoever; but may be easily solved by

H allow-

Dispute
about Di-
gestion in
the human
Body, if
performed
by Attrition
solely,
or a Men-
struum.

allowing a simple Mechanical Pressure to take Place. We are however by no Means to conclude from this, as some have too rashly done, that in the human Body Digestion is performed by a simple Attrition, otherwise we may with equal Strength of Reason, by as good Arguments drawn from what is observed in Fishes, prove that the Aliments are dissolved in our Stomachs by the Action of a *Menstruum*. But this Method of reasoning is very faulty, nor can it ever bring us to the true Solution of any philosophical or medical Problem. 'Tis very plain since the Structure of the Parts of the human Stomach are so very different from that of this Creature, that it is foolish and unreasonable to imagine both of them capable of producing the same Effects. At each End of the Stomach, there are as it were two particular Sacs of a different Texture from the rest of the Stomach, not consisting of strong *Muscular Fibres*; they seem to be Receptacles for the Stones (especially at the End which is farthest

farthest from the Orifice) while the digested Aliment is protruded into the *Intestines*.

The *Duodenum* begins pretty near *Duodenum*. the same Place, at which the *Oesophagus* enters; yet notwithstanding the Vicinity of these two Tubes, the Aliments are in no Danger of getting out before they are perfectly digested, by reason of a Protuberance or *Septum Medium* betwixt the Orifices, and in those Creatures who have such a strong muscular Stomach, 'tis a Matter of great Indifference, whether the Entry of the *Oesophagus* or *Pylorus* be highest, provided that the Entry from the *Oesophagus* does not allow the Food to regurgitate, since the Force of the Stomach can easily protrude it towards the *Duodenum*. This Gut is mostly in the Right-side, and hangs pendulous in their *Abdomen*, having it's two Extremities fixed to the Liver.

The *Ductus communis Choledochus* enters near it's Termination, where it mounts up again to be fixed to the

*Ductus
Choledochus.*

Liver; and lest, by the Contraction of the *Intestines*, the *Bile* should pass over without being intimately blended with the *Chyle*, that *Duct* enters downwards contrary to the course of the Food, and contrary to what is observed in any of the Animals we have mentioned yet. But still the general Intention is kept in View, in allowing these Juices the fairest Chance of being intimately blended with the Food.

*Intestina
Tenuia.*

The small Guts are proportionally larger than those of *Carnivorous* Birds, for the general Cause already assigned. At the End of the *Ilium* they have two large *Intestina Cæca*, one on each Side, which serve as Reservoirs to the *Fæces*, which after some *Remora* there regurgitate into what soon becomes the *Rectum*, which, together with the Excretories of Urine, and Organs of Generation, empties itself into the common *Cloaca*. The small *Intestines* are connected by a long loose *Mesentery*, which has little or no Fat accompanying the Blood Vessels,

fels, there being no Hazard of the Blood's being stopped. There are no Lacteal Vessels, *Glandulæ Vagæ* or *Pancreas Assellii* to be observed here. The *Meseraic Veins* are proportionally very large, if you either compare them with the corresponding Arteries, or consider them with respect to the Guts themselves. The want of Lacteals, *&c.* is supplied by these Veins; as a Proof of these having a Communication with the Guts, in larger Fowls the Guts can be distended by blowing in at the *Meseraic Vein*; and from this Difference of Structure, the Use of the *Glandulæ Vagæ*, &c. can easily be assigned, viz. the *Chyle* in these Animals, that have Lacteals, being to be mixed with the Blood in a considerable Quantity at a Time, lest it's Particles should attract one another too strongly, and so hinder this Mixture; it was therefore necessary it should be well diluted by the *Humores Inquilini*, which bear a very great Proportion to the Quantity of pure *Chyle*; since the *Lymph* from the inferior Extremi-

*Lacteal
Vessels,
how sup-
plied.*

*Their Use
in other
Animals.*

ties, *Abdominal Viscera*, Neck, &c. are poured into it. Here there was no Hazard of any such Inconveniency by the *Chyle* being mixed with the Blood in small Proportion from the immense Number of the small Extremities of the *Meseraic Veins*.

Pancreas.

The *Pancreas* in the Creature lies betwixt the two Folds of the *Duodenum*, and sends two or three *Ducts* into this Gut pretty near the *Biliary*.

The Spleen.

The Spleen is here of a round globular Figure, situated between the Liver and Stomach, and betwixt these and the Back-bone it enjoys the same Properties as in other Animals, viz. large Blood Vessels, &c. All its Blood is sent into the *Vena Portarum*, and has a perpetual Conquassation. It has no Excretory as far as we know. Their Liver is divided into two equal Lobes by a *Pellucid Membrane*, running according to the length of their Body; and hence we may observe, that it is not proper to that Bowel to lye on the Right-side, which is still more confirmed

Liver.

firm'd by what we observe, in Fishes, where it almost lies in the Left-side.

The Shape of their Gall-Bladder is *Vesica fellea* not much different from that of *Quadrupeds*, but is thought to be longer in Proportion to the Size of the Animal, and is farther removed from the Liver; though in Fishes it is still further removed, not being at all contiguous; and in them the *Ductus Hepaticus* and *Cysticus* don't unite till just at the Entry into the Gut. In these Animals, viz. Fishes, there seems to be no way of the *Bile* getting into the Gall-Bladder but by Regurgitation.

The principal Difference to be remarked in their Heart, is the want of the *Valvula Tricuspides*, and their Place being supplied by one fleshy Flap. Cor.

The Lungs are not loose within the Cavity of the *Thorax*, but fixed to the Bone all the Way; neither are they divided into Lobes, as in those Animals that have a large Motion in their *Spine*. They are two red spongy *Pulmones, their Structure and Uses.*

Bodies covered with a *Membrane* that is pervious, and communicates with the large *Vesicles* or Air Bags that are dispersed over their whole *Abdomen*, which *Vesicles* serve two very considerable Uses; the one is to render their Bodies specifically light, when they have a Mind to ascend and buoy themselves up when flying, by distending their Lungs with Air, and also straiten their *Trachea Arteria* and so return the Air.

The Use of the Vesicles in the Abdomen.

The Diaphragm, how supplied.

Secondly, they supply the Place of a muscular *Diaphragm* and strong *Abdominal Muscles*; producing the same Effects on the several contained *Viscera*, as these Muscles would have done without the Inconveniency of their additional Weight; and conducting as much to the Exclusion of the Egg and *Fæces*.

Trachea Arteria.

The *Trachea Arteria*, near where it divides, is very much contracted, and their Voice is principally owing to this Coarction. If you listen attentively to a Cock crowing, you will be sensible

ble that the Noise does not proceed from their Throat; but deeper; nay this very Pipe, when taken out of their Body and cut off a little, after it's Division and blown into, will make a squeaking Noise, something like the Voice of these Creatures. On each Side, a little higher than this Contraction, there's a Muscle arising from their *Sternum*, which dilates the *Trachea*. The *Cartilages*, of which the Pipe is composed in this Animal, go quite round it; whereas in Men and *Quadrupeds*, they are discontinued for about one fourth on the back Part, and the intermediate Space filled up by a *Membrane*. Neither is the *Trachea* so firmly attached to their *Vertebræ* as in the other Creatures we have examined. This Structure we shall find of great Service to them, if we consider, that had the same Structure obtained in them as in us, their Breath would have been in Hazard of being stopped at every Flexion or twisting of their Neck, which they are frequently obliged to. This we may be sensible of

of by bending our Necks considerably on one Side, upon which we shall find a great Straitness and Difficulty of Breathing; whereas their *Trachea* is better fitted for following the Flexions of the Neck by it's loose Connection to the *Vertebrae*: and as from the Structure of the *Trachea* it cannot yield to every Cause distending the *Oesophagus* as in us, it was proper they should be placed at a greater Distance from each other, which we accordingly find they are.

In Place of a *muscular Diaphragm*, this Creature has nothing but a thin *Membrane* connected to the *Pericardium*, which separates the *Thorax* and *Abdomen*. But besides this, the whole *Abdomen* and *Thorax* are divided by a longitudinal *Membrane* or *Mediastinum* connected to the Lungs, *Pericardium*, Liver, Stomach, and to the Fat lying over their Stomach and Guts, which is analogous to an *Omentum*, and supplies it's Place.

The

The Kidneys lye in the hollow ex- Kidneys.
 cavated in the Side of the Back-bone,
 from which there is sent out a blueish
 coloured Canal, running along by the
 Side of the *Vas deferens*, and termi-
 nates directly into the common *Cloaca*.
 This is the *Ureter*, which opens by a
 peculiar Aperture of it's own, and not
 at the *Penis*. This Creature having
 no *Vesica urinaria*, it was thought
 by some they never passed any Urine,
 but that it went to the Nourishment
 of the *Feathers*, but this is false; for
 that whitish Substance that you see
 their greenish *Fæces* covered with, and
 which turns afterwards chalky, is their
 Urine. Let us next consider the Or-
 gans of Generation of both Sexes, and
 first those of the Male.

The *Testicles* are situated one on The Or-
 each side of the Back-bone, and are gans of Ge-
 proportionally very large, to the Crea- neration in
 ture's Bulk. From these run out the *Vasa* the Male.
Seminifera, at first streight, but after
 they recede farther from the Body of
 the

the *Testicle* they acquire an undulated or convoluted Form, as the *Epididymis* in Man. These Convolutions partly supply the want of *Vesiculæ Seminales*, their Coition being at the same Time very short; these terminate in the *Penis*, of which this Creature has two, one on each side of the common *Cloaca* pointing directly outwards, and are very small and very short, hardly so big as a Millet Seed; whence they have escaped the Notice of Anatomists, who have often denied their Existence. This is what is chiefly remarkable in the Organs of the Male.

Vitellarium.

The *Racemus Vitellorum* being analogous to the *Ovaria* in the human Subject, are attached by a proper *Membrane* to the Back-bone. This is very fine and thin, and continued down to the *Uterus*. It's Orifice is averse with respect to the *Ovaria*, yet notwithstanding by the Force of the *Orgasmus Venereus*, it turns round and grasps the *Vitellus*, which in it's Passage thro' this *Duct*, called the *Infundibulum*, receives

ceives a thick Gelatinous Liquor, secreted by certain Glands. This, with what it receives in the *Uterus*, compose the white of the Egg. By this Tube then it is carried into the *Uterus*.

The *Uterus* is a large Bag, placed at the End of the *Infundibulum*, full of Wrinkles on it's Inside; here the Egg is completed, receiving it's last *Involucrum*, and the Shell is at last pushed out at an Opening in the Side of the common *Cloaca*. From the *Testes* in the Male being so very large, in Proportion to the Body of the Creature, there must necessarily be a great Quantity of *Semen* secreted; hence the Animal is salacious and becomes capable of impregnating so many Females. The want of the *Vesiculæ Seminales* is in some Measure supplied by the Convolutions of the *Vasa deferentia*, and by the small Distance betwixt the secreting and excretory Organs. The two *Penes* contribute also very much to their short Coition, at which Time the opening of the *Uterus* into the *Cloaca*

The want of the Vesiculæ Seminales, how supplied.

Cloaca is very much dilated, that the Effect of the *Semen* on the *Vitelli* may be the greater.

A Hen will of herself indeed lay Eggs, but these are not impregnated, and yet appear intirely complete, except that the small black Spot, which comes afterwards to be the Rudiments of the Chick, is not here to be observed. After having observed the Contents of the *Abdomen* and *Thorax*, we next proceed to examine the Parts about the Neck and Head.

Tongue,
it's Form.

These Creatures, as was observed of Fowls in general, have no Teeth, which would have been needless, as they swallow their Food intire; but their Tongue is made pretty firm, lest it should be hurt by the sharp Points of the Grain they feed on. It is of a triangular Figure and pointed before; and as by the depending Posture their Meat is in Hazard of falling out of their Mouths, to prevent this, there are several small pointed *Papillæ* standing

ing out upon their Tongue and Palate, with their Points inclined backwards, allowing an easy Passage to the Food, but hindering it's Return.

We have here, no *Velum Palatinum*, *Uvula*, or *Epiglottis*, and in Place of two large Holes opening into the Nose, there's only a long narrow *Rima* supplied with pretty strong Muscles, and such another supplies the Place of a *Glottis*. The Creature has a Power of shutting both at Pleasure; and the Nature of their Food seems not only to exempt them from the Hazard of it's getting into the Nose or *Trachea*, but it's sharp Points would hurt an *Uvula*, or *Epiglottis*, if they had any. Hence we see with what Difficulty they swallow Dough or other sort of Food that can be easily moulded into any Form.

Their *Cranium* is more *Cellular* and *Cranium*. *Capernous* than ours, by this Means, their Heads are light, yet strong enough to resist external Injuries, for the enlarging

ing the Diameter of Bones contributes to their Strength. By this *cavernous Cranium* the Organ of Smelling is considerably enlarged, and further finging Birds, as is observed by Mr. Ray and Mr. Derham, have this *cavernous* Structure of the Brain still more observable; and we are told that the Cavity of the *Tympanum* communicates with the Cells; but this I am apt to believe, so far as I could find from Dissection, is rather founded on Theory than Matter of Fact. Their Brain is covered with the common *Membranes*, but it's external Surface is not formed into so many *Gyræ* or Convolutions as ours. It's anterior Part is quite solid, of a cineritious Colour, and so far has a Resemblance of the *Corpora Striata*, as to give Rise to the *Olfactory Nerves*. The whole of it appears to us as imperfect, and we can scarce determine whether there be any Thing analogous to a third or fourth Ventricle; neither the *Corpus Callosum*, *Fornix*, *Nates*, or *Testes*, &c. can be observed here; which Parts therefore cannot be imagined

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gined as absolutely necessary for the Functions of Life, since we find these Creatures perform them sufficiently well. We may perhaps think these serve a particular Use in Man, who is a rational Creature, but then *Quadrupeds* enjoy them in common with Man. These Protuberances, &c. seem rather to depend on the different Disposition of the several Parts, being variously connected and meeting in different Directions in different Places, than their being absolutely necessary for any particular Use, and the Uses that have been assigned to different Parts of the Brain by Authors, seem to me to have no Foundation but in the Author's Fancy. I have already owned my Ignorance of the Uses of the particular Parts of the Brain, so shall not pretend to give Reasons for their being different in different Animals, but all seem to agree in this, that the *Cerebrum* has always Hollows and Vacuities in it, but the *Cerebellum* none.

*The Organ
of Smelling.*

Their Organ of Smelling is very large and well provided with Nerves ; hence they have this Sensation very acute. Ravens and other Birds of Prey give a sure Proof of this by their being able to find out their Prey though concealed from their Sight, and at a considerable Distance.

Those Birds that grope for their Food in the Waters, Mud, &c. have large Nerves which run quite to the End of their Bills, by which they find out and distinguish their Food.

Eye.

The anterior Part of their Eyes (instead of having the *Sclerotic* Coat continued, so as to make near a Sphere as in us) turns all of a sudden flat ; so that here the *Sclerotic* makes but half a Sphere ; and the *Cornea* rises up afterwards, being a Portion of a very small and distinct Sphere ; so that in these Creatures there is a much greater Difference betwixt the *Sclerotic* and *Cornea* than in us. Hence their Eyes do

do not jut out of their Heads as in Man and *Quadrupeds*. As most of these Creatures are continually employed in Hedges and Thickets, therefore that their Eyes might be secured from these Injuries, as well as from too much Light when flying in the Face of the Sun, there's a very elegant Mechanism in their Eyes, which is a *Membrane* rising from the internal *Canthus* of the Eye, which at Pleasure, like a Curtain, can be made to cover the whole Eye, and this by Means of a proper Muscle that rises from the *Sclerotic Coat* and passing round the *Optic Nerves* runs through the *Musculus Oculi Attollens* (by which however the *Optic Nerves* are not compressed) and *Palpebra* to be inserted into the Edge of this *Membrane*. Whenever this Muscle ceases to act, the *Membrane* by it's own Elasticity again discovers the Eye. This Covering is neither *Pellucid* nor *Opaque*, both which would have been equally inconvenient, but being somewhat transparent, allows as many Rays to

enter as to make any Object just visible, and is sufficient to direct them in their Progression. By Means of this *Membrane* it is that the Eagle is said to look at the Sun. *Quadrupeds*, as we mentioned before, have a *Membrana Nictitans*, but then it only can cover that Part of the Eye which is never covered by their Eye-lids.

*Bourse
Noire.
It's De-
scription
and Uses.*

Besides, all Fowls have another Particularity, whose Use I think is not so well understood, and that is a pretty long black triangular Purse rising from the bottom of their Eye just at the Entry of the *Optic Nerve*, and stretched out into their vitreous Humour, and one would imagine it gave some Threads to the Crystalline. This the *French* (who, as far as I know, were the first who took Notice of it in their Dissections before the Royal Academy) give the Name of *Bourse Noire* to. This may possibly serve to suffocate some of the Rays of Light, that they may see Objects more distinctly without hurting their Eyes. It has a Con-
nection

nection with the Vitreous, and seems to be joined also to the Crystalline Humour. If we suppose it to have a Power of Contraction, (which may be as well allowed as that of the *Iris*) it may so alter the Position of the Vitreous and Crystalline Humours, that the Rays from any Body may not fall perpendicularly upon the Crystalline; and this seems to be necessary in them, since they cannot change the Figure of the anterior Part of their Eye so much as we can do; and as this Animal is exposed often to too great a Number of Rays of Light, so they having no *Tapetum*, have the bottom of their Eye wholly black on the *Retina*, and in Consequence of this Fowls see very ill in the Dark.

They have no external Ear, but in Organ of Hearing. Place thereof a Tuft of very fine Feathers covering the *Meatus Auditorius*, which easily allow the Rays of Sound to pass them, and likewise prevent Dust, or any Insect from getting in. An external Ear would have been in-

convenient in their passing through Thickets and in flying, &c. A Liquor is separated in the external Part of the Ear or *Meatus Auditorius* to lubricate the Passage, and further prevent the Entrance of any Insects, &c. The *Membrana Tympani* is convex externally, and no Muscles are fixed to the Bones of their Ear, which are rather of a Cartilaginous Consistence; any tremulous Motions impressed on the Air are communicated in these Creatures, merely by the Spring and Elasticity of these Bones, so probably the *Membrane* is not so distended as in the human Ear, where this is done by Muscles. The *Cochlea* and *Semicircular Canals* are very distinct and easily prepared.

The Anatomy of a Carnivorous Fowl.

WE come next to the Birds of Prey, and for an Example shall take a Stenbil. The principal Difference

rence to be observed in them, is in their *Chylopoietick Viscera*, which may be accounted for from their different way of Life.

Immediately under their *Clavicles*, *Ingluvies*. you will observe the *Oesophagus* expanded into their *Ingluvies*, which is proportionally less than in the *Granivorous* Kind, since their Food does not swell so much by Maceration, and for the same Reason there is a less Quantity of a *Menstruum* to be found here.

They have also a *Ventriculus Succenturiatus* plentifully stored with *Ventriculus Succenturiatus*. Glands, situated immediately above their Stomach, which we see here is evidently *membranous*, otherwise than in the *Granivorous* Kind, and this Difference, which is almost the only one we shall find betwixt the two different Species of Fowls, is easily accounted for from the Nature of their Food, which requires less Attrition, being easier of Digestion than that of the other Kind; nevertheless it seems

I 4 requisite

requisite it should be stronger than the human to compensate the want of *Abdominal* Muscles, which are here very thin.

Intestina.

The same Mechanism obtains in this Creature's *Duodenum*, that we have hitherto observed. As being a *Carnivorous* Animal it's Guts are proportionally shorter than those of the *Granivorous* Kind, for the Reason first given, viz. it's Food being more liable to corrupt, therefore not proper to be long detained in the Body, and for that Reason it has no *Intestina Cæca*, of which the other Species of Fowls have a Pair. The Difference in their Wings, Backs, and Claws are obvious, and have been already in some Measure observed.

There is a full Description of the different Parts of the Egg, with the Changes that happen in the Time of Incubation, in the second Volume of the *Medical Essays*.

The

The Anatomy of Fishes.

AQUEOUS Animals are generally divided into such as have Lungs; and such as want them. The first Species differ very inconsiderably from an Ox or any other *Quadruped*, and are not easily procured, so that all I have to say on Fishes, shall be taken from that Species, which is not provided with Respiratory Organs.

Of these we may first observe, that they have a very strong thick *Cuticle* ^{*Cuticula, Likeness to the human.*} composed evidently of a great Number of Scales laid one on another like the Tiles of Houses; this among other Arguments serves to prove the human *Epidermis* to be of a squamous Structure. In the next Place these Creatures have neither anterior nor posterior Extremities, as *Quadrupeds* ^{*Swimming, how performed.*} and Fowls: for their Progression is performed in a different Way from ^{*Several Uses of*} either of these Species of Animals; ^{*their Fins, Tail, Air Bags, &c.*} for this Purpose they are provided with
 Machines

Machines properly consisting of a great Number of elastic Beams, connected to one another by firm *Membranes*, and with a Tail of the same Texture; their *Spine* is very moveable towards the posterior Part, and the strongest Muscles of their Bodies are inserted there. Their Tails are so framed as to contract to a narrow Space when drawn together to either Side, and to expand again when drawn to a streight Line with their Bodies, so by the Assistance of this broad Tail, and the Fins on their Sides, they make their Progression much in the same Way as a Boat with Oars on it's Sides and Rudder at it's Stern. The perpendicular Fins situated on the superior Part of their Body keep them in *Æquilibrium* hindering the Belly from turning uppermost, which it would readily do, because of the Air Bag in the *Abdomen* rendering their Belly specifically lighter than their Back, but by the Resistance these Fins meet with when inclined to either Side, they are kept with their Backs always uppermost.

most. The best Account of this Matter we have in the Treatise before mentioned, viz. *Borelli de Motu Animalium*, Part I. Chap. 23.

It may be next observed, that these Creatures have nothing that can be called a Neck, seeing they seek their Food in an horizontal Way, and can move their Bodies either upwards or downwards as they have Occasion by the Contraction or Dilatation of their Air Bag; a long Neck, as it would hinder their Progression, would be very disadvantageous in the Element they live in.

The *Abdomen* is covered on the inferior Part with a black coloured thin *Membrane* resembling our *Peritoneum*. It is divided from the *Thorax* by a thin *Membranous* Partition which has no muscular Appearance, so that we have now seen two different Sorts of Animals that have no muscular *Diaphragm*.

These

*Teeth, for
what
made.*

These Creatures are not provided with *Teeth* proper for breaking their Aliment into smaller Morfels, as the Food they use is generally small Fishes or other Animals that need no Trituration in the Mouth, but spontaneously corrupt and gradually dissolve into a Liquid *Chyle*. Their *Teeth* serve to grasp their Prey and hinder the Creatures they have once caught from escaping again. For the same Purpose the internal *Cartilaginous* Basis of the *Bronchi*, and the two round Bodies situated in the posterior Part of the Jaws, have a great Number of Tenter-hooks fixed into them in such a manner, as that any Thing can easily get down, but is hindered to get backwards. The Water that is necessarily taken in along with their Food in too great Quantities to be received into their Jaws in Deglutition, passes betwixt the *Interstices* of the *Bronchi*, and the Flap that covers them. The Compression of the Water on the *Bronchi* is of considerable Use to the Creature,

Creature, as we shall explain by and by.

The *Oesophagus* in these Creatures is very short, and scarcely distinguished from their Stomach, seeing their Food lies almost equally in both. The Stomach is of an oblong Figure. There are commonly found small Fishes in the Stomach of large ones, still retaining their natural Form, but when touched they melt down into a Gelly. From this and the great Quantity of Liquors poured into their Stomachs, we may conclude that Digestion is solely brought about in them, by the dissolving Power of a *Menstruum*, and that no Trituration happens here.

The Guts in these Animals are very short, making only three Turns, the last of which ends in the common *Cloaca* for the *Fæces*, *Urine* and *Semen*, situated about the middle of the inferior Part of their Bodies.

What

Pancreas.

What I call *Pancreas*, some gave the Name of *Intestinula Cæca* to; it consists of a very great Number of small Threads, like so many little Worms, which all terminate at last in two larger Canals, that open into the first Gut, and pour into it a viscous Liquor much about the Place where the *Biliary Ducts* enter. Their *Intestines* are connected to the Backbone by a *Membrane* analogous to a *Mesentery*. No *Lacteals* have been yet observed, and it's probable their Aliment is taken in by the *Meseraic Veins*.

Their Liver is very large, of a whitish Colour, and lies almost in the Left-side wholly, and contains a great deal of Fat.

*Liver,
Gall-Bladder,
and
their Ducts,*

The Gall-bladder is situated a considerable Way from the Liver, and sends out a Canal, the *Cystic Duct*, which joins with the *Hepatic Duct* just at the Entry into the Gut; some Fibres are stretched

stretched from the Liver to the Gall-Bladder, but none that I know of have hitherto discovered any Cavity in these Cords; so in this Animal it should seem impossible that the *Bile* can be carried into the Gall-Bladder in the ordinary Way, and consequently must either be secreted on the Sides of that *Sac*, or regurgitate into it from the *Canalis Choledochus*.

The *Spleen* is placed near the Back-bone, and at a Place where it is subjected to an alternate Pressure from the Constriction and Dilatation of the Air-Bag, which is situated in the Neighbourhood. Since in all the different Animals we have dissected, we find the *Spleen* attached to somewhat that may give it a Conquassation, as in the human Subject and *Quadrupeds*, it is contiguous to the *Diaphragm*, in Fowls it is placed betwixt the Back-bone, the Liver and Stomach, in Fishes it lies on the *Saccus aërius*, and since we find it so well served with Blood Vessels, and all it's Blood returning into the Liver; we must not conclude the *Spleen*

Spleen, it's Use drawn from Anatomy.

to be an *inutile Pondus*, only to serve as a Balance to the Animal *pro æquilibrio*, but particularly designed for preparing the Blood to the Liver.

*Organs of
Generation.*

The only Organs of Generation in this Animal are two *menstruous Bags* situated in the *Abdomen* uniting near the *Podex*. These in the Male are filled with a whitish firm Substance called the *Milt*, and in the Female with an infinite Number of little *Ova* clustered together, of a redish yellow Colour called the *Roe*. Both these at Spawning Time we find very much distended, whereas at another Time the Male Organs can scarce be distinguished from the Female, nor is there any proper Instrument in the Male for throwing the Seed into the Organs of the Female as in other Creatures. I shall not take upon me to determine the Way whereby the Female Sperm is impregnated, but we find that the Spawn of Frogs consists in the small Specks wrapt up in a whitish glutinous Liquor; these Specks

are the Rudiments of the young Frogs which are nourished in that Liquor, till they are able to go in Search of their Food. In the same Way the *Ova* of Fishes are thrown out and deposited in the Sand, the Male being for the most Part ready to impregnate them, and they are incubated by the Heat of the Sun. It is curious enough to remark with what Care they seek for a proper Place to deposite their *Ova*, by swimming to the Shallow, where they can better enjoy the Sun's Rays, and shun the large Jaws of other Fishes. The River Fishes again spawn in some Creek free from the Hazard of the impetuous Stream. But whether this mixture be brought about in Fishes by a simple Application of the Genitals to each other, or if both of them throw out their Liquors at the same Time in one Place, and thus bring about the desired Mixture, is not easy to determine; the later, I think, seems most probable. These Creatures are so shy that we cannot possibly get to observe their Way of Copulation,

K

and

and are consequently but little acquainted with their natural History.

*The Air-
Bladder,
and it's
Uses.*

After raising up the black *Peritoneum*, there comes in View an oblong white membranous Bag, in which there is nothing contained but Air. This is the Swimming-bladder; it lies close to the Back-bone and has a pretty strong muscular Coat, whereby it can contract itself. By contracting this Bag, they can make the Muscles specifically heavier than water and so readily fall to the Bottom; whereas the *muscular Fibres* ceasing to act, they become specifically lighter than Water and so swim above. According to the different Degrees of Contraction and Dilatation of this Bladder, they can keep higher or lower in the Water at Pleasure. Hence Flounders, Soles, Raia, and such other Fishes as want this *Sac*, are found always groveling at the bottom of the Water: it is owing to this that dead Fishes (unless this *Membrane* has been previously broke) are found swimming a
Top,

Top, the *muscular Fibres* then ceasing to act, and that with their Bellies uppermost ; for the Back-bone cannot yield, and the distended *Sac* is protruded into the *Abdomen*, and the Back is consequently heaviest at it's upper Part according to their Posture. There is here placed a glandular Substance containing a good Quantity of red Blood, and all the *Red* in their Body is contiguous to this Air Bag, excepting the Guts. From the anterior Part of the Bag go out two *Processes* or *Appendices*, It's Processes, or Communication with the Ventricle. which, according to the Gentlemen of the *French Academy*, terminate in their Fauces: but I never could find out this Communication either by tracing them, pouring in Mercury or Water, &c. I put it is true a Probe through them, but then with the same Strength I could have put it through the Sides of the *Processes*, so that I am afraid this is *gratis Dictum*, and that there is here as in some other Places of the human Body an *Aer Insitus*.

Ureters.
Vesica Uri-
naria.
Urethra.

At the superior Part of this Bag there are other *Red* coloured Bodies, of a glandular nature which are connected with the Kidneys. From them the *Ureters* go down to their Insertion in the *Vesica Urinaria*, which lies in the lower Part of the *Abdomen*, and the *Urethra* is there produced which terminates in the *Podex*.

Dia-
phragm.

These last mentioned parts have not hitherto been observed in some Species of Fishes, whence Authors too hastily denied them in all. These Creatures have a *membranous Diaphragm* which forms a *Sac*, in which the Heart is contained. It is very tense and almost perpendicular to the *Vertebrae*.

The Heart
has but one
Auricle
and one
Ventricle.

The Heart is of a triangular Form with it's Base downwards, and it's *Apex* uppermost, which Situation it has because of the *Branchiae*. It has but one *Auricle* and one *Ventricle*, because they want Lungs; and one great Artery. The Size of the *Auricle* and *Ventricle* are much

much the same; the Artery sends out numberless Branches to the *Branchiae* or Gills.

The *Branchiae* lye in two large Slits at each Side of their Heads, and seem to be all they have that bears any Analogy to Lungs. Their Form is Semi-circular, they have a vast Number of *red Fibrillae* standing out on each Side of them like a Fringe, and very much resemble the Vane of a Feather. These *Branchiae* are perpetually subjected to an alternate Motion and Pressure from the Water; and we may here remark, that we have not found any *red* Blood but in Places subjected to this alternate Pressure; this observation will help us in explaining the Action of the Lungs upon the Blood. Over these Gills there is a large Flap, allowing a Communication externally, by which the Water they are obliged to take into their Mouths with their Food, finds an exit without passing into their Stomach; it's owing to these Flaps coming so far down that the Heart is said

The Branchiae. Their Structure, and Use.

com-

commonly to be situated in their Heads.

Cerebrum.

Their Brains are formed pretty much in the same Way as that of Fowls, only we may observe that the Posterior Lobes bear a greater Proportion to the anterior.

Organ of Smell.

Their Organ of Smelling is large, and they have a Power of contracting and dilating the Entry into their Nose as they have occasion. It seems to be mostly by their acute Smell that they discover their Food; for their Tongue seems not to have been designed for a very nice Sensation, being of a pretty firm cartilaginous Substance, and common Experiment evinces, that their Sight is not of so much Use to them as their Smell in searching for their Nourishment. If you throw a fresh Worm into the Water, a Fish shall distinguish it at a considerable Distance, and that this is not done by the Eye, is plain from observing, that after the same Worm has been a considerable Time in the Wa-

ter

ter and lost it's Smell, no Fishes will come near it: but if you take out the Bait and make several little Incisions into it so as to let out more of the odoriferous Effluvia, it shall have the same Effect as formerly. Now it is certain, had the Creatures discovered this Bait with their Eyes, they would have come equally to it in both Cases: In Consequence of their Smell being the principal Means they have of discovering their Food, we may frequently observe their allowing themselves to be carried down with the Stream that they may ascend again leisurely against the Current of the Water; thus the odorous Particles swimming in that Medium, being applied more forcibly to their smelling Organs, produce a stronger Sensation.

The *Optic Nerves* in these Animals are not confounded with one another in their middle Progress betwixt their Origin and the Orbit, but the one passes over the other without any Communication, so that the Nerve that

*Optick
Nerves.*

comes from the Left-side of the Brain goes distinctly to the Right-eye: And *vice versa*.

*The Cry-
stallin Hu-
mour a com-
pleat Sphere,
and why.*

The *Lens Crystallina* is here a compleat Sphere, whereas in Men and all other Terrestrial Animals it consists of two Portions of unequal Spheres laid on one another; to account for this, it must be considered that these Creatures have got no Aqueous Humour, as the Rays that come to their Eyes are conveyed through a *Medium* of the same Density with that Humour in other Animals, and consequently would have gone on in a streight Line without any Refraction till they came to the *Lens*, although they had been provided with an Aqueous Humour; thus then the Rays impinging upon their *Lens* have hitherto suffered no Refraction; that they might therefore be sufficiently refracted and meet in a Point on the *Retina*, it was necessary the *Lens* should be made more convex than it is in other Creatures who have the Rays considerably refracted

refracted in their Passage from the Air through the aqueous Humour.

As Fishes are continually exposed to Injuries in the uncertain Element they live in, and as they are in perpetual Danger of becoming a Prey to the larger ones, it was necessary their Eyes should never be shut, and in Consequence of this they are not provided with *Palpebræ*; but then as in the Current itself the Eye must be exposed to several Injuries, there was a Necessity it should be sufficiently defended, which in Effect it is by a firm *Pellucid Membrane* that seems to be a Continuation of the *Cuticula*, being stretched over here. The *Epi-dermis* is very proper for this Purpose, as being insensible and destitute of Vessels, and consequently not liable to Obstructions or by that Means of becoming opaque.

Whether Fishes have a Sense of *Fishes, if*
Hearing or not is very uncertain: All *they hear*
that has the Appearance of an Or- *or not.*
L gan

gan of Hearing in these Creatures is a Bone, about the Bulk of one half of a common Bean of a particular Structure, being very brittle and composed of a great many different *Segments* laid at one another's Sides, and situated in a particular Form at the Side of the Brain; is then the Idea of Sound communicated to them by Means of this Bone? Or does their running away, at stamping hard on the Ground, or crying loud, depend upon some other kind of Sensation? This may possibly be produced in them, by a tremulous Motion communicated to their Bodies by the circumambient Water, which is put in Agitation, from the like Concussions happening in the Air or neighbouring Ground.



F I N I S.

Whether Fishes have a Sense of Hearing or not is very uncertain: All that has the Appearance of an Organ

